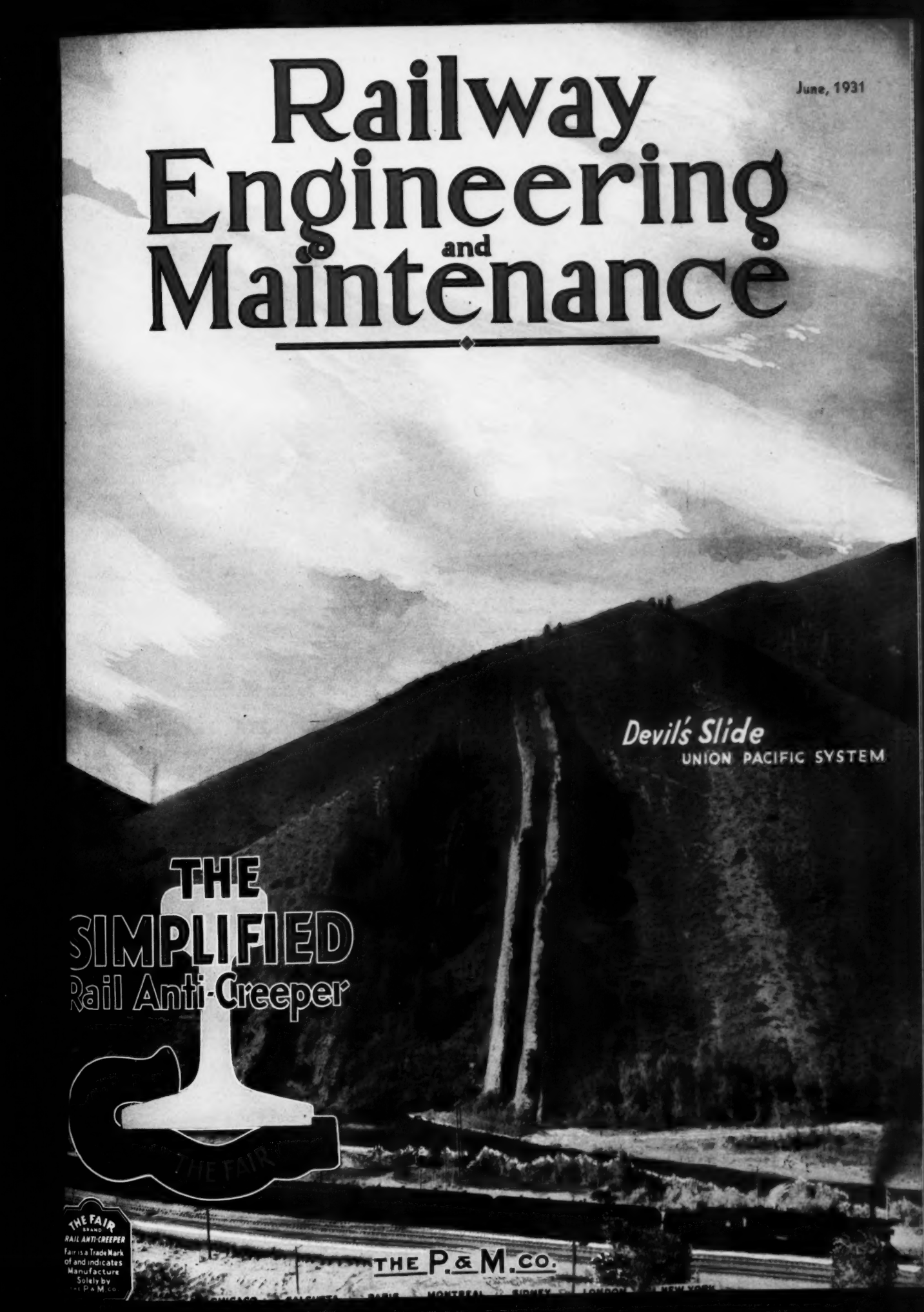
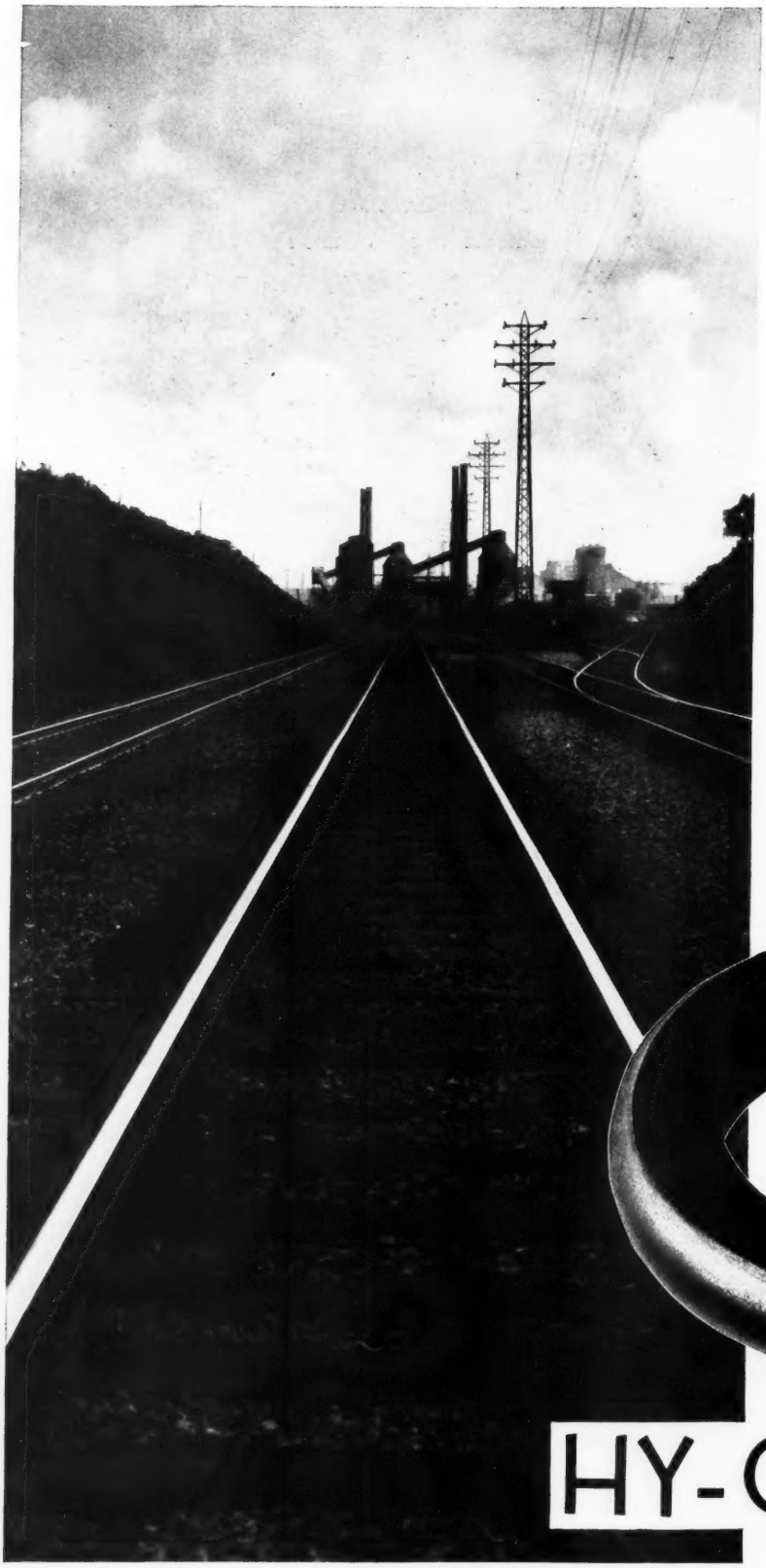
Railway Engineering and Maintenance

June, 1931



Rails carrying *heaviest* traffic *prove the value of* HY-CROME



ON main line, where heavy traffic moves continuously at high speeds, HY-CROME spring washers are most essential—maintaining proper bolt tension at the rail joint. Here, where a loose joint can cause the most trouble and expense, *depend on HY-CROME.*

HY-CROME compensates for wear and stretch under all conditions. It is always at work—a permanent, non-fatiguing, automatic compensating device that has long since proved its efficiency.

When HY-CROME is applied maintenance inspections grow fewer—they are needed less often. *Less maintenance means greater economy.* Pioneering this device enables us to prove it.

THE
RELIANCE MANUFACTURING CO.
MASSILLON, OHIO
Engineering Materials, Ltd., McGill Bldg.
Montreal, Quebec, Canada

HY-CROME
Reg. U. S. Pat. Office

RAILWAY ENGINEERING AND MAINTENANCE
Published monthly by Simmons-Boardman Publishing Co., at 2200 Port Washington Road, Milwaukee, Wisconsin. Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00 a year. Single copy, 35 cents. Entered as second class matter February 14, 1931, at the postoffice at Milwaukee, Wisconsin, under the Act of March 3, 1879.

Alphabetical Index to Advertisers, Page 596 Classified Index to Advertisers, 592-594

Using Treated Cross Ties *is not enough*

For Utmost Economy They Must Be *Plated Properly*

ALL the care and money spent for preservative treatment is lost if tie plates are used which cut into the treated layer of the timber.

You DO get proper protection from Lundie Tie Plates. Millions in service prove it. There are no sharp projections—instead the bottom has a series of rounded steps which hold track to gauge without cutting a single fibre of the tie.

Lundie Tie Plates guard against tie depreciation. Their use effects big economies, longer tie life and fewer renewals. They assure full return from treated cross ties.

The Lundie Engineering Corporation

285 Madison Avenue, New York
59 East Van Buren Street, Chicago

LUNDIE TIE PLATE

IMAGINE . . . an Ice Box on Wheels!

. . . Yet Parker Earle's "Crazy Idea" changed a nation's eating habits— created a two billion dollar industry!

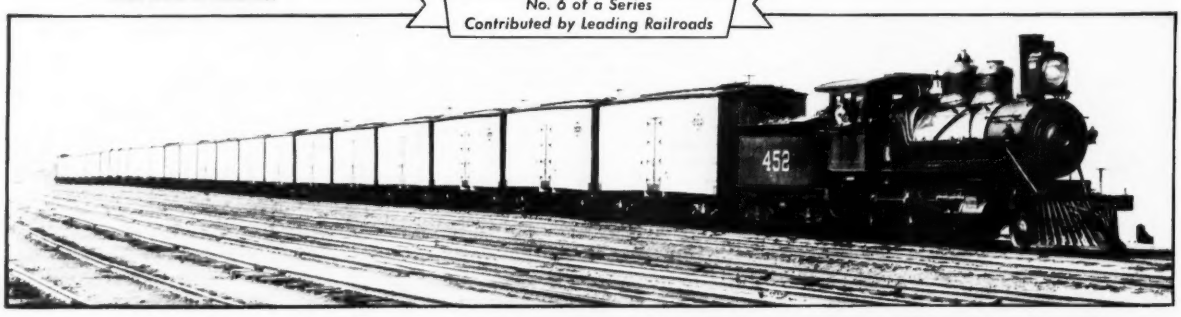
Grapefruit, bananas, pineapples—those familiar fruits—were once so scarce that the mere eating of them was an event of a lifetime.

Parker Earle's first crude shipping ice-box so revolutionized both agriculture and the standard of living that it should rightfully take its place with McCormick's Reaper or Whitney's Cotton Gin. On its maiden trip in 1868 it delivered ripe strawberries in perfect condition to Chicago markets, 323 miles distant—an achievement that led the carrier, the Illinois Central System, to participate in further experiments which resulted in the modern refrigerator car.

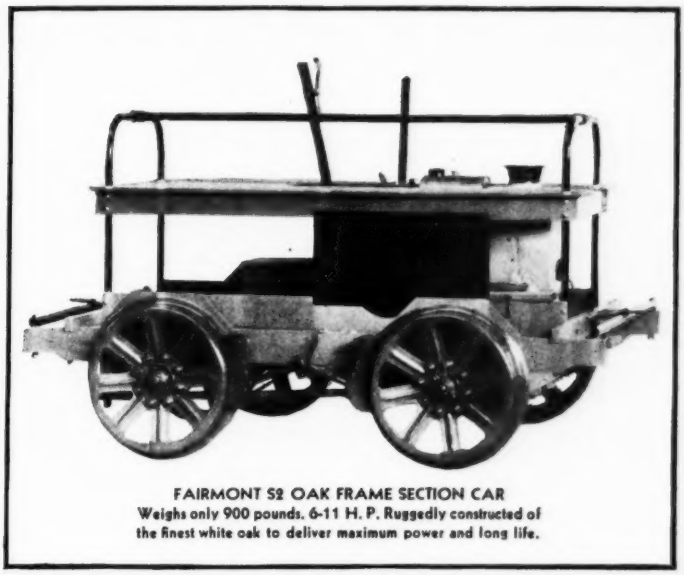
Since experimental days to now, when not only fresh produce, but meats, fish, dairy products and perishable medical supplies are shipped from coast to coast—refrigerated shipping has been a major interest of the Illinois Central System. Of one item alone — bananas — the Illinois Central transports over 30,000 carloads yearly. Lemon-growers of Sardinia, banana-cutters of Guatemala, and pineapple-planters of Hawaii—not to mention millions of American farmers—owe their prosperity to Earle's ice-box.

The first all-refrigerator fruit train in America.

No. 6 of a Series
Contributed by Leading Railroads



THE RAILROAD WORLD



FAIRMONT S2 OAK FRAME SECTION CAR
Weighs only 900 pounds. 6-11 H. P. Ruggedly constructed of the finest white oak to deliver maximum power and long life.

And FAIRMONT, too, has Pioneered . . .

Equally as revolutionary, when first introduced, were the improvements that have come to be identified with Fairmont engineering. To mention the most significant contributions—consider the Endless Cord Belt Drive, Water-cooled Motor, and Ball-bearing Crankshaft. The fact that they are now standard equipment on nearly all railway cars shows their importance.

But Fairmont holds in higher esteem the distinction of a complete line of *good* cars, so well designed and capably constructed that they hold all records for *Lowest Over-all Cost* in railroad service. That is why the great majority of cars now riding the rails are Fairmont products.

As a pioneer, Fairmont is doubly obligated to advance even further the standard of Fairmont performance and service.

FAIRMONT RAILWAY MOTORS, INC. FAIRMONT, MINNESOTA, U. S. A.

General Sales Offices: 1356 Railway Exchange Bldg., CHICAGO

District Sales Offices: New York City Washington, D. C. St. Louis San Francisco New Orleans

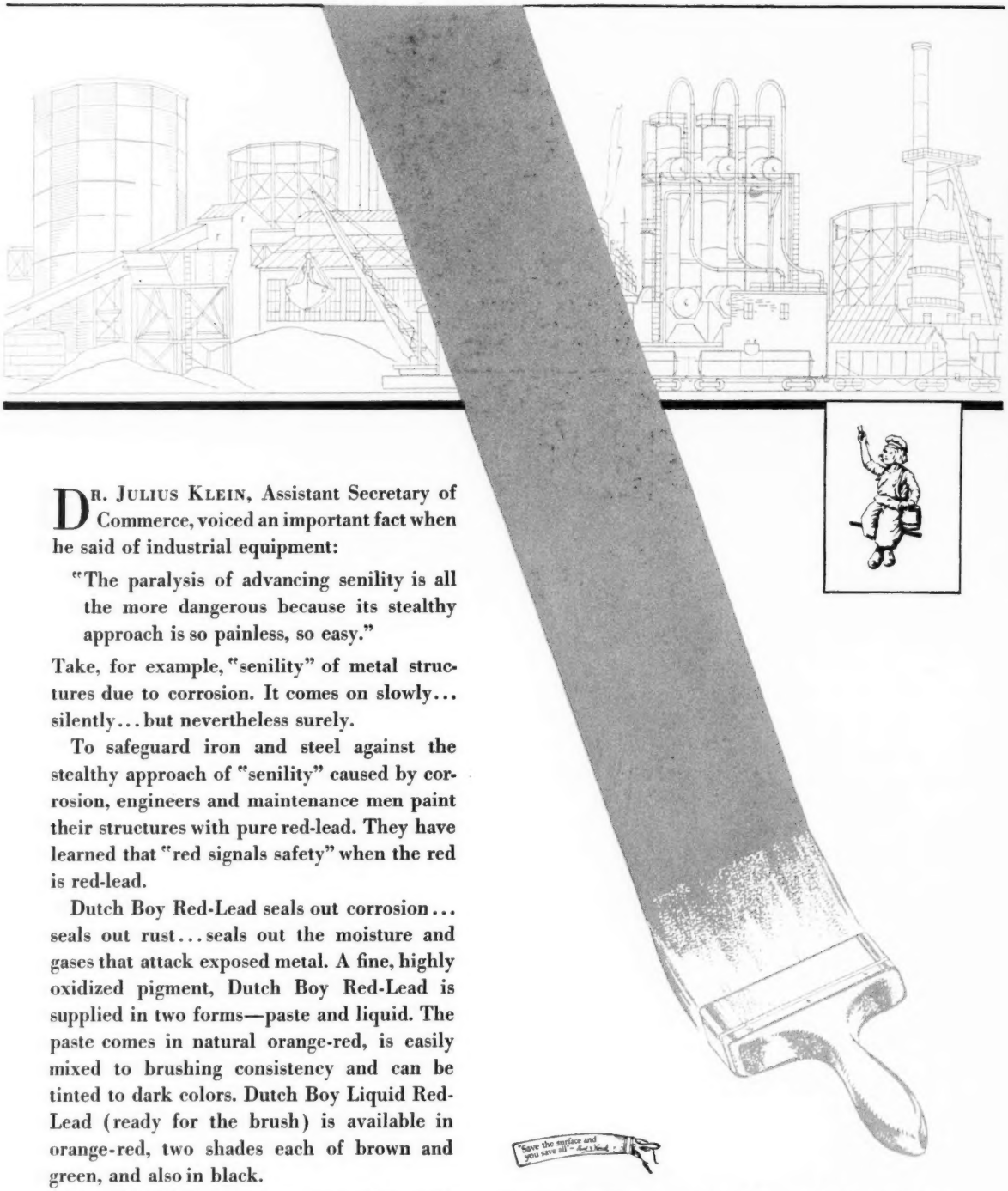
FAIRMONT RAILWAY MOTORS, Ltd., Toronto, Canada
Foreign Representative: THE BALDWIN LOCOMOTIVE WORKS

Manufacturers of section motor cars, inspection motor cars, gang and power cars, weed burners, mowers, ballast discers, ball and roller bearing engines, push cars and trailers, roller axle bearings, wheels, axles and safety appliances.

Fairmont Mudge
Performance on the Job Counts

KNOWS FAIRMONT

WHERE RED SIGNALS SAFETY



DR. JULIUS KLEIN, Assistant Secretary of Commerce, voiced an important fact when he said of industrial equipment:

"The paralysis of advancing senility is all the more dangerous because its stealthy approach is so painless, so easy."

Take, for example, "senility" of metal structures due to corrosion. It comes on slowly... silently... but nevertheless surely.

To safeguard iron and steel against the stealthy approach of "senility" caused by corrosion, engineers and maintenance men paint their structures with pure red-lead. They have learned that "red signals safety" when the red is red-lead.

Dutch Boy Red-Lead seals out corrosion... seals out rust... seals out the moisture and gases that attack exposed metal. A fine, highly oxidized pigment, Dutch Boy Red-Lead is supplied in two forms—paste and liquid. The paste comes in natural orange-red, is easily mixed to brushing consistency and can be tinted to dark colors. Dutch Boy Liquid Red-Lead (ready for the brush) is available in orange-red, two shades each of brown and green, and also in black.

For full information about protecting metal surfaces with red-lead, write for our booklet —"Structural Metal Painting." Our nearest branch will gladly forward a copy upon request.

"Save the surface and you save all" — Dutch Boy

NATIONAL LEAD COMPANY

New York, 111 Broadway—Buffalo, 116 Oak Street—Chicago, 900 W. 18th Street —Cincinnati, 659 Freeman Avenue—Cleveland, 820 West Superior Avenue—St. Louis, 722 Chestnut Street—San Francisco, 2240 24th Street—Boston, National-Boston Lead Co., 800 Albany Street—Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Ave.—Philadelphia, John T. Lewis & Bros. Co., Widener Bldg.

DUTCH BOY RED-LEAD

SIMPLICITY

makes the Northwest worth more

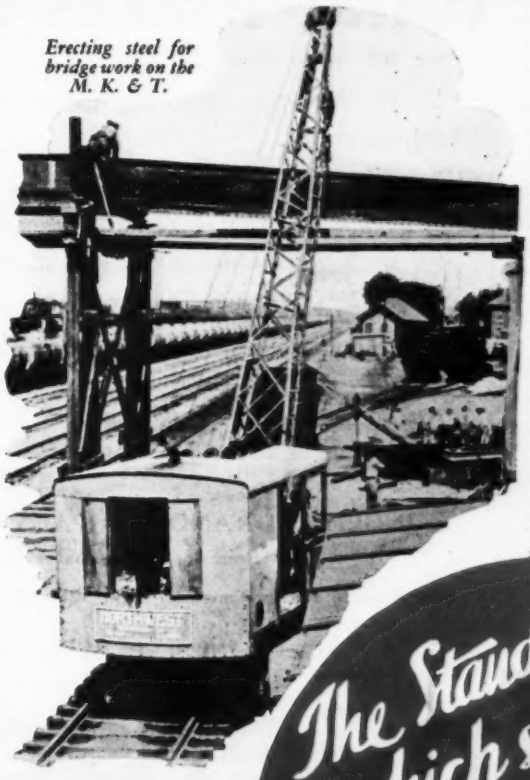
COMPARE the Northwest crawler with other machines! Simplicity of design is one of its valuable features.

Follow the line of power through the helical gear drive to the operating mechanism. Note that there are only two main shafts above the deck. Note that all high speed shafts are mounted on ball bearings. Note that the A-frames do not support the drums. All mechanism is back of the center pin and mounted low for stability—and the whole is mounted on a single heavily webbed steel casting.

Here is *simplicity*—freedom from chains, piping, unnecessary gears and shafts! Here is ease of upkeep that keeps operating costs down.

One of the reasons why 42% of the crawlers sold to railroads are Northwests.

Erecting steel for bridge work on the M. K. & T.



NORTHWEST ENGINEERING CO.

The world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines

1713 Steger Building 28 East Jackson Boulevard
Chicago, Illinois, U. S. A.

NORTHWEST

MORE MACHINE FOR THE DOLLAR INVESTED!

The Standard by which shovels and cranes measured

What makes for best results?

There are two important factors that should be considered in specifying tamping equipment:

1. The most efficient and reliable machines and tools. Ingersoll-Rand Tie Tamper Compressors and Tools are without doubt the most highly developed machines for track work built today. We invite a thorough examination of the features of all I-R machines and tools.

2. Competent instruction in the care and operation of the units; proper organization of gangs, etc. In this connection, Ingersoll-Rand is prepared to offer a superior service because of its long experience—extending from the introduction of pneumatic tamping over 18 years ago.

INGERSOLL-RAND COMPANY - 11 Broadway - New York City

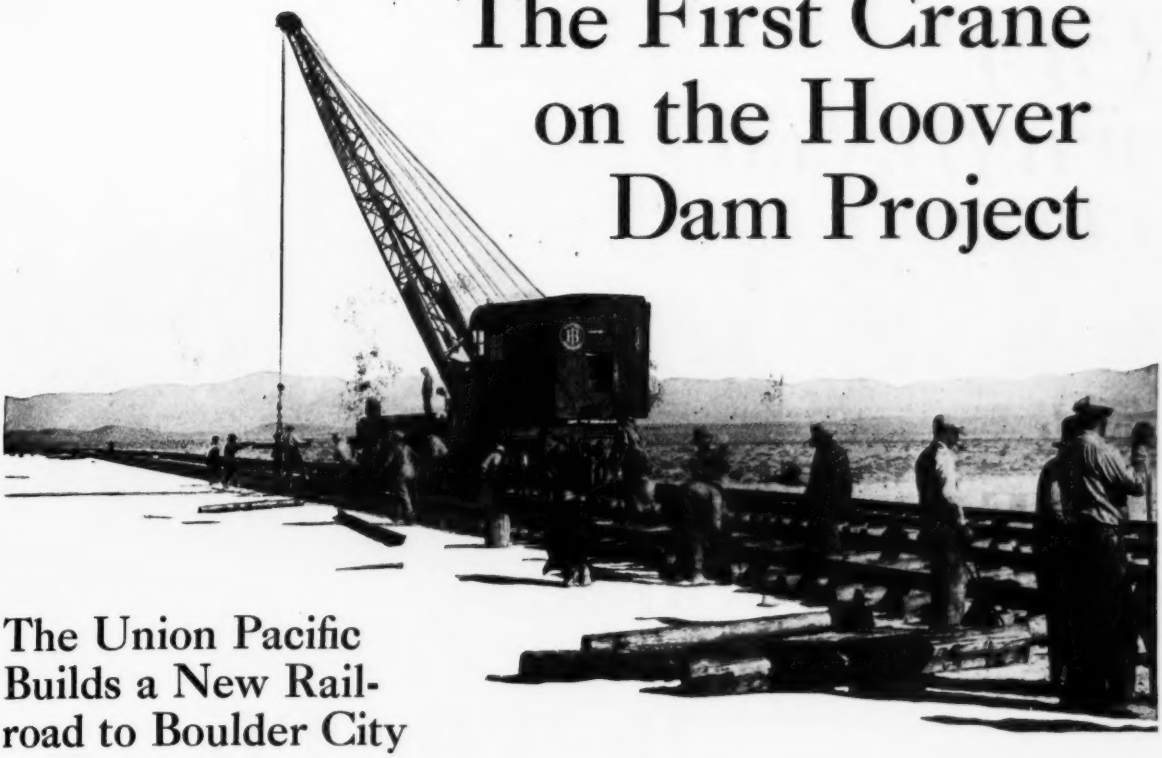
Branches or distributors in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 620 Cathcart St., Montreal, Quebec

266-TT

Ingersoll-Rand

The First Crane on the Hoover Dam Project



The Union Pacific Builds a New Railroad to Boulder City

The building of a 22-mile railroad across the Nevada desert to Boulder City was the first unit let on the Hoover Dam project. This contract was awarded to the Union Pacific Railroad and the illustration shows their first equipment to go over the rails—a No. 5 Industrial Brownhoist gas locomotive crane.

Laying ninety-pound rail, this Industrial Brownhoist averaged a mile a day for the last half of the work. In one eight-hour day 5680 feet were laid and this record could have been increased by several hundred feet had the rail been available.

Ask any Industrial Brownhoist owner, and there are thousands of them, about the uninterrupted, low cost handling service obtained from these cranes. Their universal reply of satisfactory performance is the reason, of course, why these cranes are seen wherever important jobs are under way. It is the reason, too, why you would find an Industrial Brownhoist a big money saver on your own handling work.

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, New Orleans, San Francisco, Cleveland.

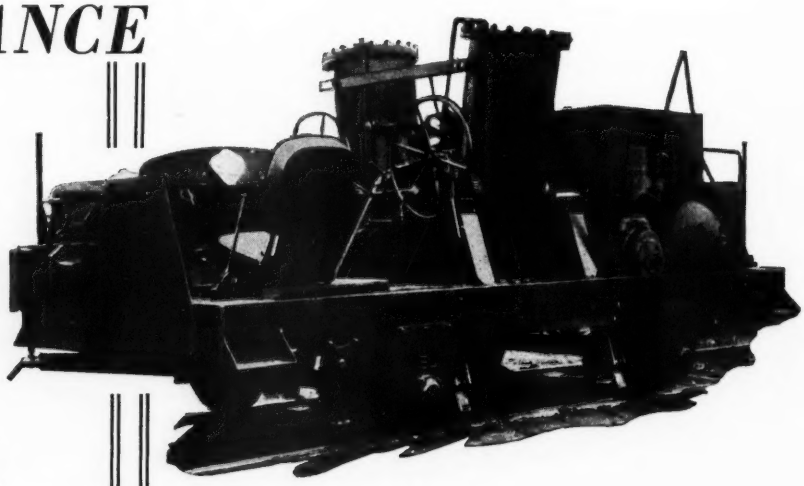
Plants: Brownhoist Division, Cleveland; Industrial Division, Bay City, Michigan; Elyria Foundry Division. Elyria, Ohio.

INDUSTRIAL BROWNHOIST

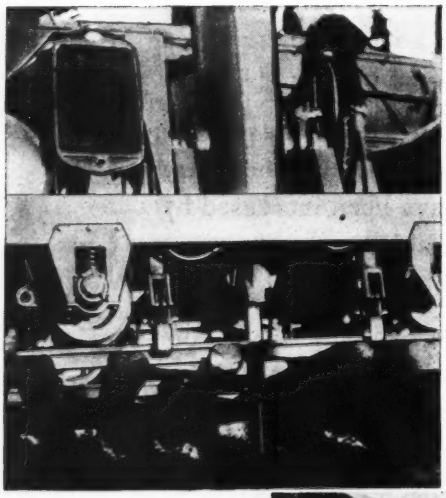
CUT MAINTENANCE COSTS

with

THE BUTLER AIR WAY



TRACK MASTER



This all duty maintenance machine offers the simplest, most efficient and economical solution to the problem of maintenance cost reduction.

Combined in the BUTLER AIRWAY TRACKMASTER you have an air compressor . . . track jack . . . gang car and light switching engine.

This machine will more than double the track ballasting mileage of any crew. Maximum track shifting and lifting are greatly simplified and speeded up. And the machine requires only one operator.

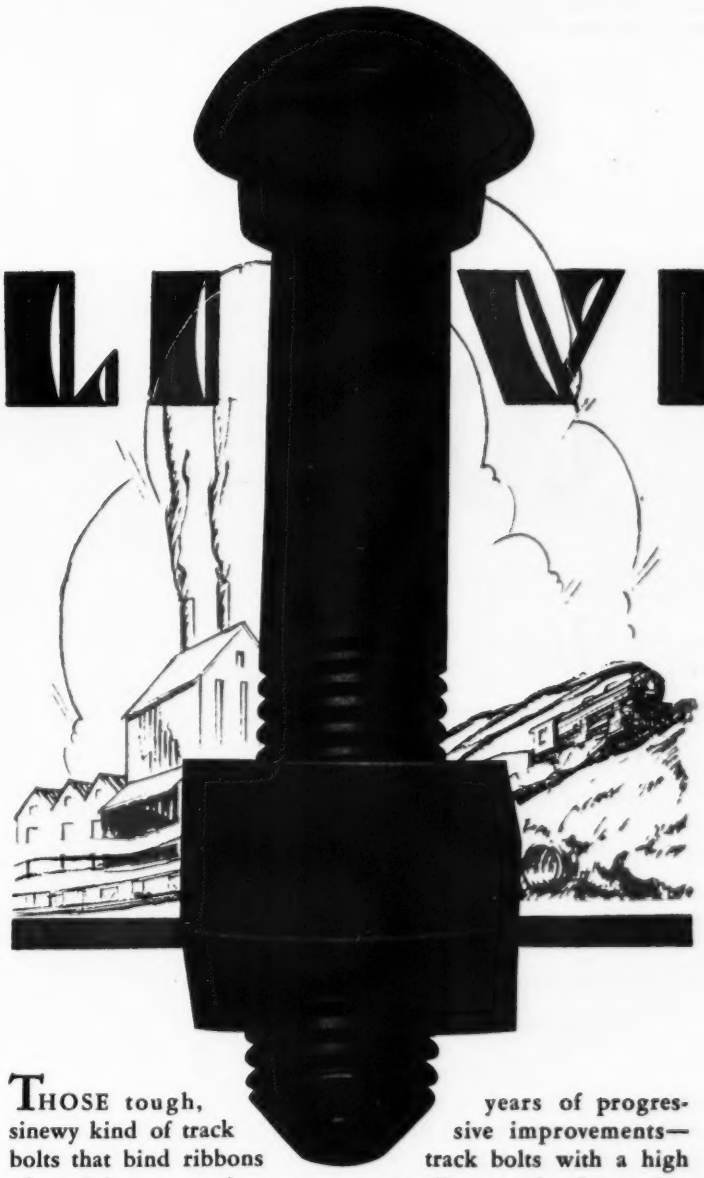
In successful operation over two years.

Full details concerning its application to your various maintenance jobs will be gladly furnished.

BALDWIN-SOUTHWARK CORPORATION
Southwark Foundry & Machine Co. Div.
PHILADELPHIA

SOUTHWARK

OLIVER



THOSE tough, sinewy kind of track bolts that bind ribbons of steel into a continuous highway—the kind of bolts that are super heat treated to resist the shearing strains of hard-driving railroad service to a superlative degree.

The OLIVER Track Bolts you buy today are the result of 68 years of progressive improvements—track bolts with a high tensile strength—the equal to the hardest railroad service.

Moreover, OLIVER Track Bolts are time-tried and time-proved—their record in the railroad industry speaks for itself. "OLIVER" is always a good name to specify.

TRACK BOLTS

OLIVER IRON AND STEEL CORPORATION

PITTSBURGH

Branch Offices in the Principal Cities

With nineteen years' experience in railroad welding and cutting, The Oxweld Railroad Service Company is prepared to supply the best methods and materials for applying the oxy-acetylene process to railroad needs. Year after year, the majority of Class I railroads are finding Oxweld Railroad Service of increasing value.

THE OXWELD RAILROAD SERVICE COMPANY

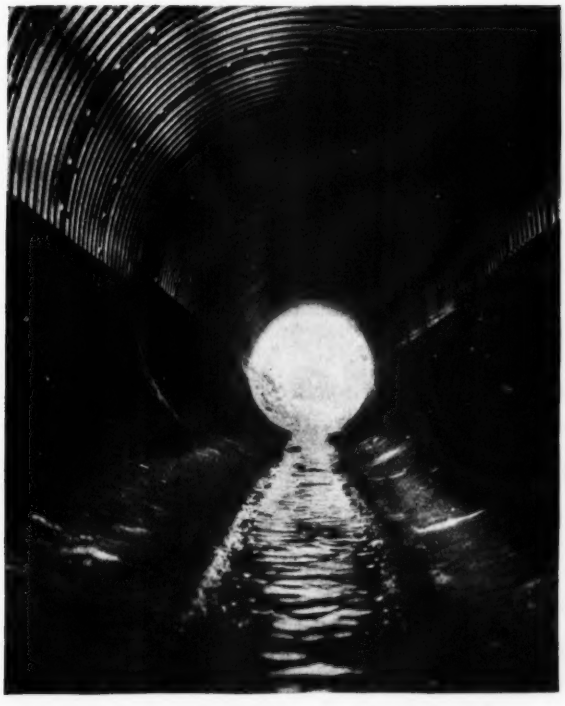
Unit of Union Carbide and Carbon Corporation

UCC

NEW YORK, Carbide and Carbon Building
CHICAGO, Carbide and Carbon Building

ARMCO Culverts

PAVED INVERT



Stream flow in Triple-paved Armco Paved Invert Culvert under a railroad near Augusta, Ga.

Effectively Resist Erosion--Hence are longer lived, Safer!

YOUR railroad maintenance dollars are wisely invested in culverts of Armco Paved Invert Pipe.

Paving the invert, *where the wear comes,* accomplishes four important things: (1) it effectively protects the base metal against erosion (2) increases the service life of the structure (3) decreases its cost per year (4) insures greater safety.

The paving itself is an exclusive Armco development—the result of years of field and laboratory study and tests. It is a tough, resilient, bituminous material which effectively resists the constant wear of hydraulic traffic.

Armco Paved Invert Pipe has a background of six years of actual service in various sections of the country as practical proof of the true worth of the paved invert principle and application. More than 2,500,000 feet of Armco Paved Invert Pipe are in use today.

Latest facts on Armco Paved Invert Culverts will be sent on request. Write today.

Armco culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.

ARMCO CULVERT MANUFACTURERS ASSOCIATION

Middletown, Ohio

SYNTRON

MAGNET HAMMER ELECTRIC

TIE TAMPERS

THE SIMPLEST TYPE OF ELECTRIC HAMMER

NO MOTOR NO GEARS

ONLY ONE MOVING PART

HOW THE TAMPER OPERATES

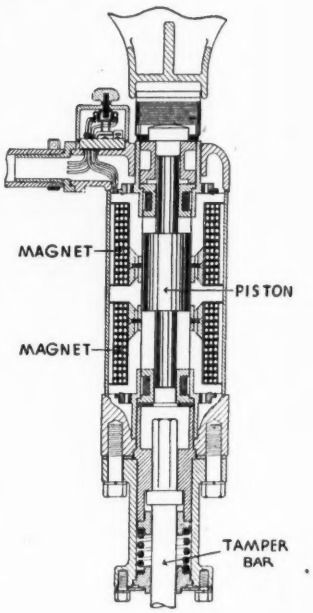
Two Magnets reciprocate the Piston that strikes a fast, hard, percussion blow on the shank of the Tamping Bar.

UNIFORM BLOWS

Regardless of Age, Wear, Weather or Effort Applied by the Operator

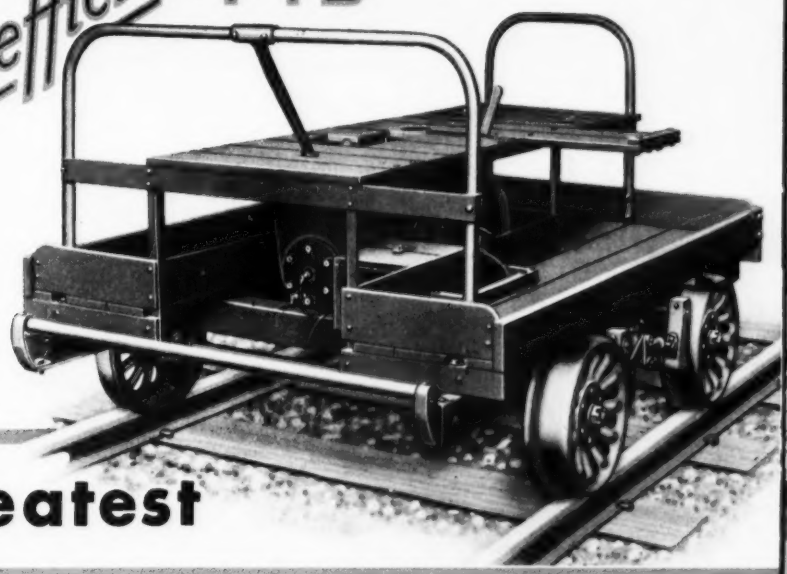
BUILT IN—2—4—6—8—12—16—TOOL OUTFITS

SYNTRON CO. Pittsburgh, Pa.



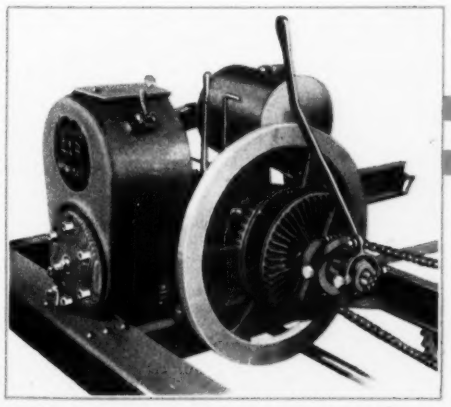
ELECTRICITY IS THE MODERN POWER

"Sheffield 44B"



The greatest dollar-for-dollar value in railway motor cars

Sheffield Motor Cars are not the lowest *priced* cars on the market. They are built with every economy known to modern production methods. But these economies include none which impair efficiency and dependability. If a car the equal of Sheffield is ever produced—the Sheffield will be lower priced. Sheffield is the *lowest overall cost* car on the market . . . The greatest dollar-for-dollar value in railway motor cars. Ask us to prove these claims.



The complete power unit of the Sheffield 44-B.

"FIRST ON THE RAILS . . . AND STILL FIRST"

Tapered Roller **TIMKEN BEARING EQUIPPED**

FAIRBANKS-MORSE
MOTOR CARS

Easy to handle!

"Sheffield No. 46

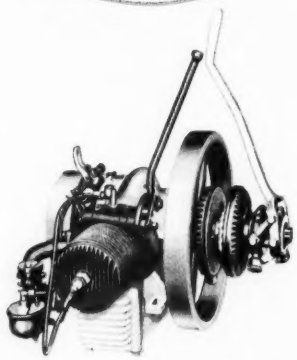
but that's not all . . .

Tapered Roller
TIMKEN BEARING EQUIPPED

The new Sheffield No. 46 One Man Inspection Car is surprisingly easy to handle. It weighs less than 400 pounds. Lifting weight is only 100 pounds!

But easy handling is only one of the features that recommend the No. 46. Here's a car that is built to take "tough going"—and *like* it. Strength has not been sacrificed. Light weight is secured by the liberal use of heat-treated aluminum alloys—as strong as steel with only one-third the weight.

Although designed as a "one man" car, the Sheffield No. 46 will accommodate two men comfortably. Plenty of room for equipment. Four wheel brakes of new design and a clutch that can't be burned out are two more features that help to make the No. 46 easy to operate and economical to maintain. Maintenance, by the way, is remarkably low.



The two-cycle engine and sturdy clutch of the Sheffield No. 46. This clutch is identical in design with that used on the Sheffield 44-B—without a failure in six years. Can't be burned out.

Write for complete information about the Sheffield No. 46—the car that has been thoroughly proved in ten months of active service under severest operating conditions.

FAIRBANKS, MORSE & CO.
CHICAGO

Manufacturers of railway motor cars; hand cars; push cars; velocipedes; standpipes for water and oil; tank fixtures; stationary and marine oil engines; steam, power and centrifugal pumps; scales; motors and generators; complete coaling stations.

FAIRBANKS-MORSE
MOTOR CARS

RA21.79

TELEWELD

A shaper bit efficiently trims the rail ends to the desired angle

THE SKILL IS IN THE TOOL

ANY UNSKILLED laborer can now effect tremendous savings on your line by eliminating destructive rail end chipping with the proven, fool-proof Teleweld Slotting Tool. With this simple, hand operated unit weighing only 110 pounds, he will bevel and slot from one-half to one mile of track a day... doing a perfect job on each joint. The Teleweld unit eliminates rail end chipping, retards batter and defers reclamation of ends by the fastest, most accurate, most economical method. Based on figures supplied by railroads using the Teleweld unit, approximately 3½ cents per joint pays for everything... labor and upkeep and retires the tool in a year's operation Save your new rail now before chipping impairs its life. A Teleweld Slotting Tool, which is sold outright, can be delivered to you immediately.

ELECTRIC RAILWELD SALES CORPORATION, RAILWAY EXCHANGE BLDG., CHICAGO

New York • Cleveland • Salt Lake City • Boise • Montreal • Spokane • San Francisco

ATLACIDE
CALCIUM CHLORATE

3 to 5 Dollars per Mile

will kill weeds on the right of way outside the ballast area

THE ATLACIDE Dusting Method is the most economical for killing weeds around

Loading Platforms
Cattle Guards
Switch Stands
Drain Ditches
Culvert Ends
Lumber Piles
Fence Lines
Tie Piles
Pole Lines
Mile Boards
Signal Poles
Bridge Bases
Water Towers
Storage Yards
Whistle Boards
Yard Limit Boards

Here's How

ONE Knapsack Duster ($20.00) will service three sections at an average cost of $1.00 per mile for the duster.

A 200 lb. drum of Atlacide ($18.00) covers 20,000 to 30,000 square feet and will rid the average right of way section of all the weeds as listed on the margin at a cost of about $3.00 per mile for chemicals. Total cost about $4.00 per mile.

Double the amount of Atlacide and you can kill the occasional patches of weeds in the ballast section.

One man with Knapsack Duster does the work of 5 men cutting weeds. The results from the Atlacide dusting method are permanent.

Order some and make the test on some of your difficult sections.

Chipman Chemical Engineering Co. Inc.
BOUND BROOK, N. J.
Chicago, Ill. Palo Alto, Cal. Houston, Tex. Atlanta, Ga. Kansas City, Mo. Winnipeg, Man.

The following is an abstract of committee report presented at the 40th Annual convention of the American Railway Bridge & Bldg. Ass'n. at Louisville, Kentucky

The Relative Advantages and Costs of Precast Concrete Crib Walls and Monolithic Walls

The advantages of precast concrete cribbing units in retaining wall construction, as compared to monolithic or poured-in-place concrete walls are as follows:

1. Lower cost of installation.

2. Greater speed of erection.

3. Immediate use on completion without waiting for curing as is necessary with concrete poured-in-place.

4. High quality of concrete scientifically manufactured under strict control methods, only possible in a well organized concrete-products plant where materials and water are properly weighed or proportioned and where proper curing is assured.

5. Can be placed on foundation soils which would require a pile or caisson sub-foundation if a heavy mass wall were constructed.

Closed-face crib wall, Grand Trunk Ry., Chicago. (Note: This is a Federal Wall of 2-Piece Concrete Cribbing Units.)

6. Slight settlement of foundation soil does not injure a cribbing wall when properly designed and erected.

7. Standardized precast units may be carried in stock, in which event their availability in an emergency is invaluable where the time element is a feature.

8. No special equipment is required and erection may be done by unskilled labor.

9. Ease of construction, removal and relocation without loss, allowable increase of height on account of future widening of banks, raise in grades, etc.

10. Provides perfect drainage without the use of tile drains and necessary sewer connections.

11. Precast cribbing has some advantages in congested terminal districts, or where right of way is restricted, where, in the construction of solid walls, encroachment on adjacent track space or private ground would be necessary. In building embankments in such places, the wall can be brought up as the filling material is being placed, which is not practicable with a poured-in-place wall.

12. Can be used easily and to great advantage when two tracks or roadways are operated on different levels and on close centers.

13. Replacement of wooden cribbing can be handled most advantageously by use of precast concrete cribbing, as one section or cell can be placed at a time with a minimum amount of shoring. In doing this the material excavated for an adjoining cell may be used as back-fill for the one just erected.

14. Minimum amount of excavation for foundation. Under ordinary conditions the removal of the top earth to a depth of one foot is sufficient for cribbing, as compared with three to four feet or more for a solid wall. Of course, each job presents its own problem in this respect and a general specification cannot be drawn to fit all cases.

16. Can be used to good advantage to retain the fill at switch stands and signal foundations where a solid wall would require deep footings.

17. Can be used for wing walls of bridge abutments along highways, especially where it is likely that the abutments will have to be widened at a later time to accommodate additional tracks.

18. Where precast concrete cribbing may be used the cost is as a rule, from 25 to 40 per cent less than for a monolithic wall to serve the same purpose.

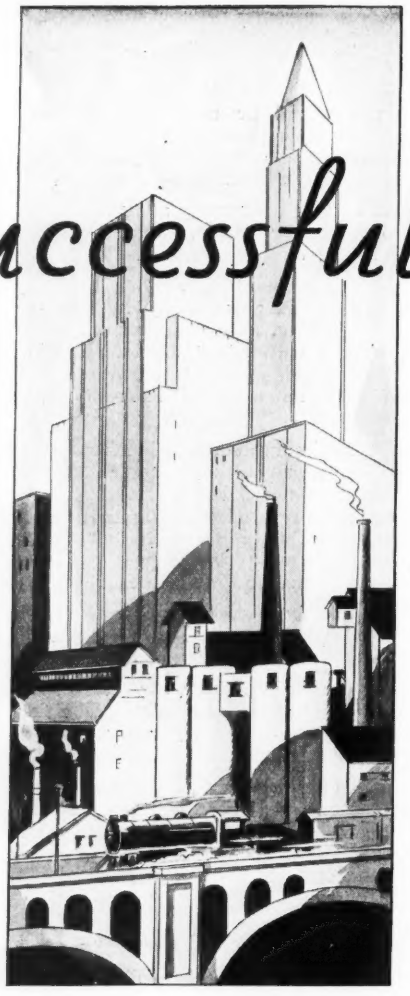
Every one of these 18 advantages of precast cribbing is a sound reason for using Federal 2-piece Concrete Units for your retaining walls—costs less than poured concrete, strong, stable, permanent, no maintenance, attractive closed-face appearance, 100% salvage if moved. In use over a period of years by the country's most prominent railroads. Booklet on request.

FEDERAL-AMERICAN CEMENT TILE COMPANY

Executive Offices: 608 South Dearborn Street - - - - Chicago

Plants Near CHICAGO - NEW YORK - PITTSBURGH - BIRMINGHAM

Concrete Products FEDERAL 2 piece Concrete CRIBBING *for Over 25 Years*



"Successful for 21 years"

that's your assurance of permanently waterproofed concrete and mortar

MEDUSA WATERPROOFED Portland Cements, white and gray, have been successfully used for twenty-one years for making Waterproofed Concrete and Mortar. Thousands of structures "Medusa Waterproofed" are your assurance of permanently waterproofed concrete. For years leading engineers, architects and contractors have met severe water conditions by specifying Medusa Waterproofed Portland Cements. Years of experience have proved to them that concrete made with this Waterproofed Cement withstands exposure to water and moisture, ground acids, and acid fumes in the air, freezing and thawing action, and changing of temperature. The "Medusa Process" of grinding Medusa Waterproofing in Medusa Portland Cements at the mill during process of manufacture means that the Waterproofing is uniformly distributed through the mass of concrete and mortar. The specification of Medusa Waterproofed Portland Cements eliminates the use of admixtures, lowers the amount of supervision, and lessens the handling of materials on the job. *Railroad concrete exposed to all kinds of conditions should be Waterproofed through the use of Medusa Waterproofed Portland Cements.* Send the coupon below for the book entitled "How to Make Good Waterproofed Concrete."

MEDUSA PORTLAND CEMENT COMPANY, 1002 ENGINEERS BUILDING, CLEVELAND, OHIO

Manufacturer of Medusa Gray Portland Cement (Plain and Waterproofed); Medusa Waterproofing (Powder or Paste); Medusa White Portland Cement (Plain and Waterproofed); Medusa Portland Cement Paint; Medusa-Mix, the Masonry Cement; and Medusa Stoneset Mortar Cement

MEDUSA
WATERPROOFED
PORTLAND
CEMENT
(WHITE OR GRAY)

Medusa Portland Cement Company, 1002 Engineers Building, Dept. O., Cleveland, Ohio

Gentlemen:—Without obligation please send me a copy of the book "How to Make Good Waterproofed Concrete."

Name of Railroad_____

Attention of _____

Address _____

City_____ State_____

Ab-so-lute-ly nothing to do

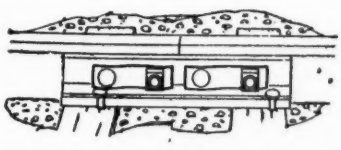
This is a picture of something that never happened.

On the best maintained track in the world there has never been a time when there was absolutely nothing to do. Maintenance engineers may grow grey hairs over the necessary jobs which they must perforce neglect for lack of money or lack of labor, but they have never been known to run out of work.

If you could release your men from any of their appointed tasks—bolt tightening, for instance—how many other tasks would claim their attention! ***Verona Rail Joint Springs*** free men from bolt tightening. After the bolts are really tight, the springs keep them tight. They need no further attention until it is time to take them out of track.

Verona Rail Joint Springs exert such a tremendous reactive pressure through such a distance, that bolt stretch, rust, wear, and all the other causes of loose bolts are immediately compensated for by the action of the springs.

Try ***Verona Rail Joint Springs*** on your new rail this year. See how many men they will release for other work.



VERONA TOOL WORKS - - PITTSBURGH

ARRIVED!

the **32-B**

GAS, DIESEL or ELECTRIC CONVERTIBLE CRANE

a new 1-yard BUCYRUS-ERIE

(rated to lift 16 tons at 12 feet radius)

Only Bucyrus-Erie can offer you all these advantages

Fast Operating Speeds — Remarkable Stability

Ample Power—(6 cylinder gas engine)

Effortless, Sure Control—Oversize clutches and brakes. Hoist clutches power set. All operating levers toggle in. Double-operating chocking brakes, applied from operator's stand. Swing brake for operating on grade. Direction of motion of operating levers can be easily changed to suit operator.

Easy Propelling—Steered from operator's stand with cab in any position. Propelling brake also controlled from stand. A friction brake locks the swing during propelling.

Profit Protection—Bucyrus-Erie ruggedness a factor of safety against break-downs and excessive repair costs. This machine is packed with mechanical improvements that cut costs.

The newest of the new Bucyrus-Erie line of universal machines, the 32-B is destined to make new history— and new profits — wherever materials are handled.

Built into this machine is the experience of over fifty years, experience gained in building more excavating machines than any other manufacturer in the world.

The 32-B is rugged, nicely balanced, powerful, fast — combining more features which increase output and lower the costs, than any other 1-yard machine.

Send for full specifications.

Faster, lower cost materials handling is here.

BUCYRUS-ERIE COMPANY, South Milwaukee, Wisconsin

Representatives throughout the U. S. A. *Branch Offices:* Boston, New York, Philadelphia, Atlanta, Birmingham, Pittsburgh, Buffalo, Detroit, Chicago, St. Louis, Kansas City, Mo., Dallas, San Francisco. Offices and distributors throughout the world.

A-317

BUCYRUS ERIE

It's COPPER-ALLOYED WITH PURE IRON that does it!

A QUARTER century ago, a metallurgical discovery of far-reaching importance was made in the laboratories of the Newport Rolling Mill Company.

This discovery revealed that the right amount of copper alloyed with Pure Iron produced a distinctive metal of extraordinary rust-resisting qualities; a metal that was ideal for culverts; that would bring a new era in economical drainage. This metal was called GOHI.

The first GOHI Corrugated Culverts were produced 23 years ago. Thousands of these culverts have been giving 100% service for upwards of 20 years, proving durability even beyond the usual needs of modern drainage. Normally, they outlast the roadbeds under which they are laid.

GOHI Culverts offer the practical advantages of light weight; easy handling; quick, low-cost installation; freedom from repairs and upkeep. Write to any GOHI Fabricator for full information.

GOHI is guaranteed to contain .2% to .3% copper and is 99.90% pure Iron-Copper alloy . . . . . That's why it lasts longer.

GOHI CULVERT MANUFACTURERS, Inc.
Newport, Kentucky

GOHI FABRICATORS

The Newport Culvert Co.
Newport, Ky.

The Pennsylvania Culvert Co.
Philadelphia, Pa.

Denver Steel & Iron Works Co.
Denver, Colo.

A. N. Eaton, Metal Products
Omaha, Nebr.

Feenaughty Machinery Co.
Portland, Oregon

Tennison Brothers
Texarkana, Ark.

Capital City Culvert Co.
Madison, Wis.

Central Culvert Co.
Ottumwa, Iowa

Roanoke Sales Corp.
Roanoke, Va.

St. Paul Corrugating Co.
St. Paul, Minn.

Tennison Brothers
Oklahoma City, Okla.

GENUINE OPEN HEARTH IRON
GOHI
TRADE MARK
PURE IRON - COPPER ALLOY
REG. U.S. PAT. OFF.

(Meet copper-bearing pure iron requirements in all accepted specifications for corrugated metal culverts.)

GOHI
PRONOUNCED "GO-HIGH"
Corrugated
CULVERTS

No. 30 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: A Promotional Service

May 20, 1931

Dear Reader:

I am wondering if you have ever thought of the part that RAILWAY ENGINEERING AND MAINTENANCE plays in the introduction of new and more efficient equipment and materials. By publishing descriptions of new equipment, improvements in old equipment and new applications of such equipment, we broadcast the discoveries of one for the benefit of all and thereby hasten their widespread utilization. That this service is of value to railway and railway supply men alike is evidenced by the many letters which we receive. We quote from three letters from readers relative to the March issue.

One letter came from the chief maintenance officer of one of our largest railway systems, from which the following is quoted:

> "I was especially interested in the article in your March issue on the painting of the Quebec bridge. This was valuable to me in view of the fact that some of us on our system have divergent views as to whether steel bridges should be painted by the spray gun method."

Another letter came from one of our field representatives, who reported on a call made as follows:

> "Mr. ____, assistant chief engineer of the ____ railway would like to secure another copy of the March issue of Railway Engineering and Maintenance as quickly as possible. He said that he had to get some equipment. He is in the market for a rail-laying machine, air compressor, air drills, air hose, a cement gun and a mechanical tie tamper. He already has the rails distributed for the job."

From a paint manufacturer, we received the following letter:

> "We are writing you at the suggestion of Mr. ____, our ____ representative to obtain four or five copies of your March issue. We are particularly interested in the article on pages 250-254, describing the painting of the Quebec bridge. Various individuals in our organization are most anxious to review it."

If you find the paper of similar assistance to you, we will be glad to hear from you. If, on the other hand, we fall short in meeting your needs in this respect, constructive suggestions will be equally appreciated.

Yours very truly,

Elmer T. Howson

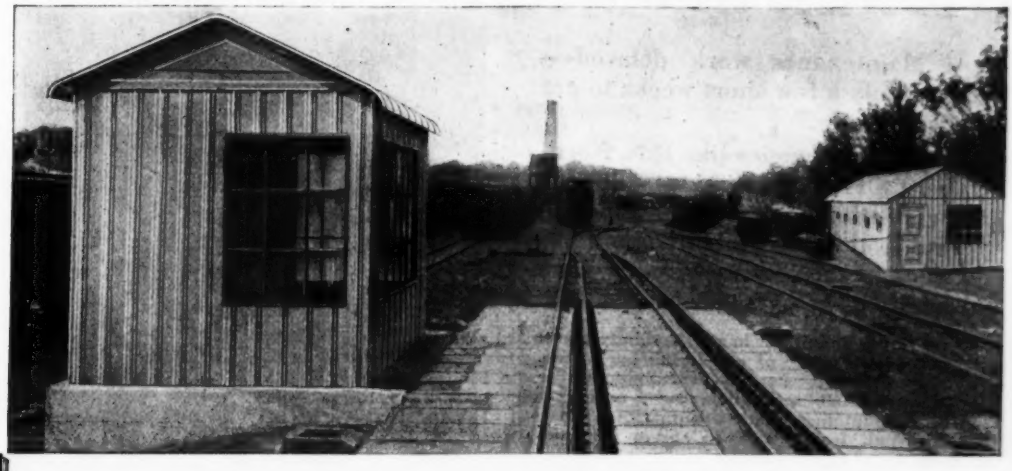
ETH*MM

Editor.

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

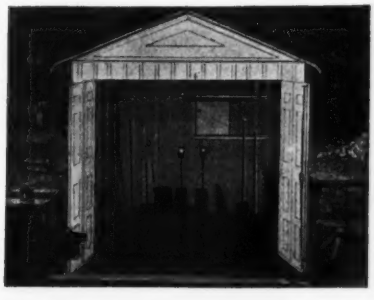
MADE ENTIRELY OF STEEL

BUTLER



This new book, picturing installations of many types of Butler Ready-made Steel Buildings awaits the request of interested railway officials.

READY-MADE STEEL BUILDINGS



Economical to Acquire . . . Economical to Transport . . . Economical to Install . . . Economical to Maintain

From any standpoint Butler Ready-made Steel Buildings fit into railroad economy programs better than any other fire-safe type of construction.

Their standardized unit design facilitates compact shipping. Ready-made construction simplifies erection to the extent that it can be accomplished by whatever labor crews are at hand. Complete materials in orderly arrangement let installation go forward without interruption. Steel construction offsets the absence of full fire fighting facilities. Permanence is inwrought in both materials and construction—yet the structural design permits enlarging, taking down and re-erecting. These advantages are available in Butler Ready-made Steel Buildings with a lower investment than for any other comparable type of structure. Butler engineering service will supply you with full details and prices on any type and size buildings now under consideration, be they **scale houses, track car houses, material depots, freight depots, car repair shops, material treating plants, machine shops, truck and bus garages, signalmen shelters, transformer or electric power houses, et cetera.**

BUTLER

BUTLER MANUFACTURING COMPANY

1247 Eastern Ave., Kansas City, Mo. 947 Sixth Ave., S. E., Minneapolis, Minn.

Crowding Months into Weeks

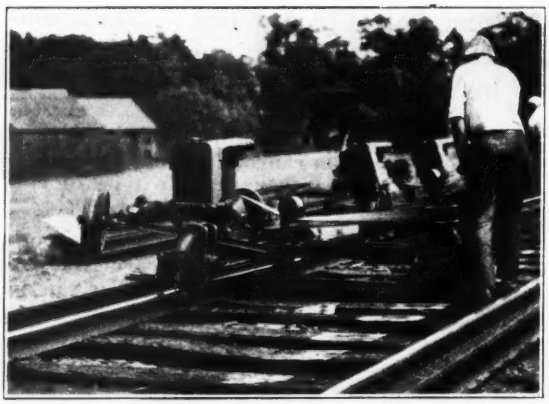
Maintenance work delayed—and only a few short weeks to get "caught up."

In emergencies like this, Nordberg Track Machines deliver every time. They enable gangs to finish the job quickly—and do work that measures up to your highest track standards.

Pulling spikes by hand has always been the "bottle neck" of rail laying operations. However, since the Nordberg Spike Puller is now available, this delay need no longer be encountered. With this machine, three men pull from 30 to 35 spikes per minute!

Nordberg Spike Puller

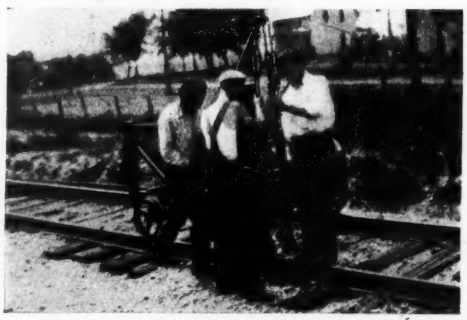
Does not damage ties nor bend spikes.



Nordberg Tie Adzer

Two machines easily keep ahead of the rail laying gang of 60 men.

Perfect seats for tie plates on every tie are secured. The rail sets level and *stays* level. Reduces future maintenance expense.



Most obstinate spikes drawn quickly and easily.

Railway Equipment Department

NORDBERG MFG. CO.

MILWAUKEE, WIS.

NORDBERG

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

JUNE, 1931

Editorials - - - - - - - - - - - - 537
Accidents—The Cutting Torch—A Ballast Plan—Economy—Education.

Meeting the Ballast Requirements - - - - - - - 540
Great Northern's plan of operation involves the working of 29 plants on a schedule designed to secure the maximum efficiency

Saving Half a Million Dollars Annually - - - - - - 544
How the Chicago, Milwaukee, St. Paul & Pacific is reducing costs and improving maintenance by programming its bridge and building work

Crosstie Producers Review Available Supplies - - - - - 551
Report greatly curtailed output brought about by reduced demand and falling prices. Also discuss measures to increase service life

Water Supplies Were Depleted - - - - - - - - 557
Drought of 1930 practically exhausted railway reserves in many parts of the country and impaired the quality of water available

Purchases and Inventories in 1930 - - - - - - - - 558
Statistical review of the expenditures of the railways for materials and supplies and of the stocks on hand at the end of the year

Tie Problem Discussed in News Bulletin - - - - - - 559
Buffalo, Rochester & Pittsburgh issues a three-page appeal to its employees asking their co-operation in conservation

What's the Answer? - - - - - - - - - - - 560

New and Improved Devices - - - - - - - - - 567

What Our Readers Think - - - - - - - - - - 569

New Books - - - - - - - - - - - - - 569

News of the Month - - - - - - - - - - - 570

Published on the last Thursday preceding the month of issue by the

SIMMONS-BOARDMAN PUBLISHING COMPANY
2200 Port Washington Road, Milwaukee, Wis.

Editorial Office
105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
17 and H Streets, N. W.

SAN FRANCISCO
215 Market Street

Edward A. Simmons, *President;* L. B. Sherman, *Vice-President;* Henry Lee, *Vice-President;* Samuel O. Dunn, *Vice-President;* C. R. Mills, *Vice-President;* F. H. Thompson, *Vice-President;* Roy V. Wright, *Secretary;* and John T. DeMott, *Treasurer.*

Subscription price in the United States, Canada and Mexico, $2.00 per year; foreign countries, $3.00. Single copies, 35 cents.

Member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.).

Entered at the postoffice at Milwaukee, Wis., as mail matter of the second class.

ELMER T. HOWSON
Editor

WALTER S. LACHER
Managing Editor

NEAL D. HOWARD
Eastern Editor

GEORGE E. BOYD
Associate Editor

M. H. DICK
Associate Editor

F. C. KOCH
Business Manager

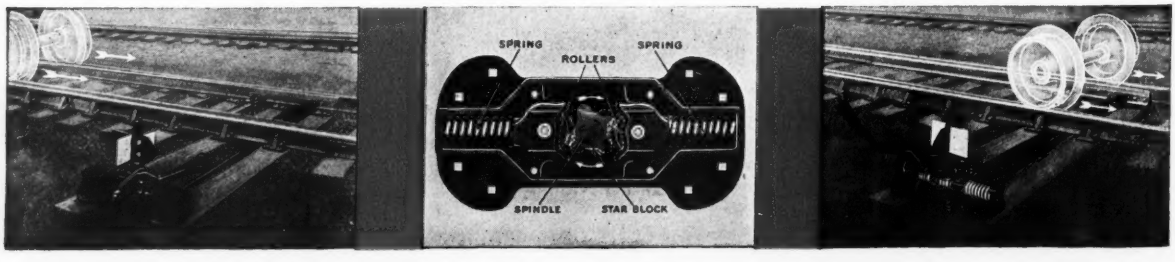
WHAT PRICE SAFETY?

Safety at any price is the hue and cry of Industry. Safety measures, holding life and property in the balance, have been designed to guard against the carelessness of human nature. Such a measure is the Ramapo Automatic Safety Switch Stand, the safety valve for busy turnouts . . . Low price safety when compared to the alternative, rigid stands.

The resilient feature of this stand, a spring mechanism which is a part of the base, produces automatic safety. Trains back into or trail through a switch operated by one of these stands without damage. When a rigid stand is employed, the same movement would have bent, cracked or broken some part of the stand or its connections. Such a condition, if unnoticed, will ultimately cause serious damage and possibly loss of life.

The Ramapo Automatic Safety Switch Stand number 20-B is especially designed for yard use. Stands with higher targets are provided in styles 17, 18 and 19. These stands fill every requirement when safety, speed, and economy are desired in yard operation.

Ramapo Safety Stands are automatic yet operate easily by positive hand-throw. They operate automatically whether the switch is locked or not. The gage of the forward wheels of a train passing through a switch operated by a 20-B closes the open point to make gage (Illus. 1). This movement is transferred through the connecting rod to the starblock on the spindle which rotates on the rollers compressing the springs (Illus. 2). In this movement some part of a rigid stand or its connections would have been bent, cracked or broken. When the switch points are approximately half thrown by the wheels making gage, the springs, which have been compressed, assure their being thrown the balance of the way (Illus. 3). The target and the lamp, moving with the points, show their new position. The stand, left latched, is ready for either rigid-hand or automatic operation. The use of Ramapo Automatic Safety Switch Stands wherever possible is both sensible and logical. May we send you full printed information? Write your nearest Ramapo office or plant.



RAMAPO AJAX CORPORATION

Racor Pacific Frog and Switch Company . . . . . Los Angeles—Seattle
Canadian Ramapo Iron Works, Limited . . . . . Niagara Falls, Ontario

General Offices—230 Park Avenue, New York

Sales Offices at Works and McCormick Building, Chicago — Midland Bank Building, Cleveland, Ohio — Builders Exchange Building, St. Paul
Metropolitan Bank Building, Washington — Union National Bank Building, Houston, Texas

Nine Racor Works: Hillburn, N. Y. Niagara Falls, N. Y. Chicago, Ill. East St. Louis, Ill. — RACOR — Superior, Wis. Pueblo, Col. Los Angeles, Cal. Seattle, Wash. Niagara Falls, Ont.

Railway Engineering and Maintenance

ACCIDENTS

A Challenge For Every Employee

"I CONGRATULATE the American railways upon the admirable results achieved in their seven-year campaign for the drastic reduction in their casualties to employees. This is a most inspiring record in the great campaign for safety in industry." This was the message telegraphed from the White House by President Herbert Hoover on May 18. In a similar vein Colonel Robert Lamont, Secretary of Commerce in President Hoover's cabinet, wrote, "The railways have been pioneers in the field of organized accident prevention. Through the extensive use of safety devices and through the individual and collective efforts of all of those included in the great army of railway men, the roads have made a great contribution to safety." While addressed specifically to the members of the Safety Section of the American Railway Association, these congratulatory messages were in reality words of commendation to every railway employee who contributed to this record by increased care in his work.

The safety movement on the railways is a most interesting one. Inaugurated at a time when industry as a whole was giving little attention to the accident problem, the idea, when first advanced, that a railway should spend its money for the purpose of preventing its employees from injuring themselves and others was considered idealistic and impractical. Yet in the last year alone, tentative reports indicate that the railways spent approximately $300,000,000 for the protection of their employees and the general public.

An Outstanding Achievement

That progress is being made in the conservation of life and limb is indicated in a striking manner by the record made by the railways in the last seven years. At its convention in June, 1924, the Safety Section of the A. R. A. adopted as a goal a 35 per cent reduction in accidents by 1930, compared with the record for 1923.

With the expiration of this period it is found that the number of passengers killed in train accidents has been reduced 83 per cent and the number injured, 70 per cent. Expressed in other terms, only seven persons were killed in train accidents in 1930, or one for each 101,000,000 passengers carried, as compared with 42 killed in 1923. Likewise the number of employees killed has dropped 52 per cent and the number injured 78 per cent. More specifically, the number of employees killed was reduced from 1,940 in 1923 to 935 in 1930, the latter being the first year, since accident statistics of this character have been compiled, that the fatalities to employees have fallen below 1,000. In the same manner the number of employees injured was reduced from 151,960 in 1923 to 35,325 in 1930. Thus the seven-year safety campaign has been responsible for a cumulative saving during that period of approximately 4,000 lives and the elimination of injuries to nearly a half million employees.

Likewise in highway crossing accidents the railways have, as stated in the last issue, made an outstanding record. In the face of an increase in automobile registration, an even greater increase in the use of motor vehicles, and an increase in fatalities of 6 per cent at all points, resulting from the use of the automobile, there were 1,122 fewer collisions at railway grade crossings in 1930 than in the preceding year, a reduction of 18.71 per cent. There were also 465 or 18.71 per cent fewer fatalities and 1,287 or 18.91 fewer injuries.

Of Personal Concern

Records such as these are of the most direct concern to every railway employee, not only because of his natural pride in the achievements of the industry to which he is devoting his life, but also because of its direct relationship to the protection of his own life and limb. How were these records attained? What influences contributed to them? What responsibility rests on supervisory officers and on individual employees? How can this record be maintained and still further improved? These are pertinent questions that deserve consideration at the conclusion of this seven-year period of endeavor.

The railways have fought a good fight in the battle against accidents but they have by no means finished the course. Every accident is one too many. Furthermore, accidents do not happen—they are caused. Behind each one is some contributing condition that should have been corrected. It is the task of every employee to be on the lookout for every such potential cause for an accident, in order that it may be corrected before some fellow employee suffers. The essence of safety work is prevention. As one foreman said recently— "My job is to prevent accidents. I want to be a preventer, not an investigator."

The safety record, excellent as it is now, compared with previous years, still affords ample opportunity for further improvement, as can be shown by a survey of the accidents that are still occurring on many roads. That such accidents are preventable and can be eliminated when the employees are properly educated and trained, is shown by the success that has attended such measures where they have been tried. As an illustration, surprise tests reduced the number of motor car collisions per year

on one road from 33 to 5. On another road, accidents caused by men being hit while getting on moving motor cars, have been eliminated by requiring the men to board the cars from behind rather than from the side or front. On still another road the practice of sending home, for 3 to 10 days, men doing goggle work without using their goggles, eliminated accidents from this cause. On a fourth road detailed instruction, of the men in large extra gangs, as to the proper way to use the claw bar when renewing spikes eliminated this type of accident.

Railway employees as a group were never so alert in promoting safety as they are today. There has never been more active rivalry between the men on different roads and between groups of employees on the same roads to prevent accidents than now. Such momentum, like advertising, must be maintained if its force is to be realized. Like not a few articles that were nationally known a decade ago but have since been forgotten and disappeared from the market because their promoters have relied on the continuation of the demand after the advertising had ceased, the safety movement will lag to the extent that each foreman and other supervisory officer relaxes his interest and ceases to make its precepts a part of his daily routine for the direction of his men.

The reduction in working forces during the last year has largely eliminated the careless employees. With the return to normal business, with its inevitable increase in force, the new man problem with its accident hazard will reappear. Every employee should accept his responsibility to so instill in each new man the necessity for care in his operations to the end that this new employee, with whom he will ultimately be called to share a joint responsibility for safety in gang work, will not constitute a hazard for either his own or his associates' welfare.

A New Goal

To provide a further incentive for renewed activities in safety work, the Safety Section of the A. R. A. has set as a new goal the further reduction within the next three years of 33 per cent in the number of casualties among employees. This is a task that will call for the best in every employee. It is a task to which he owes his whole-hearted support and co-operation for the results will accrue more largely to his own personal benefit than to that of any other individual or organization. A man's first duty is to his family. Adherence to safety principles tends to the fulfillment of that obligation.

THE CUTTING TORCH

Its Use Introduces Some New Problems

WHEN the present-day steel-bridge erector stops to recall the days before the cutting torch had been invented, he finds it hard to remember how he managed to get along without this device. The torch finds its greatest value in bridge work in the cutting up of old spans, for the saving effected by its use in the removal of old truss spans is often appreciably greater than the difference between the salvage value of old spans removed in condition for reuse and the scrap value of spans that have been cut apart in the cheapest manner possible.

Whenever prices of steel decline, the spread between the cost of new steel, or the value of usable old material, and the price of scrap increases, because scrap prices fluctuate over a wider range. Therefore, with the present extremely low price of scrap, it is harder to show on paper that there is economy in cutting up old spans rather than to take them apart for possible reuse. Obviously, the answer depends in part on the possibility of finding a place for the old span and also on the policy of the management with respect to the holding of scrap for a better price than now prevails.

It is also well to keep in mind that the cutting torch is almost equally useful in the work of adapting second-hand material to new applications. I-beam spans, unassembled shapes, bars and plates and, in some cases, built-up girders can readily be cut to fit new locations. But in all cases caution is urged with respect to the reuse of old material to insure that the plans do not call for excessive refabrication or alterations. The unit cost of such work is much higher than the unit cost of new work and a patched-up job is not as good as a new one.

EDUCATION

A Novel Plan That Works Well

MUCH has been said in the past regarding educational methods that are adapted for the training of employees to fit them better for the positions they are now holding and at the same time prepare them for promotion, provided they possess the proper qualifications. Engineering and maintenance officers almost invariably recognize that there is a growing need for the special training of the supervisory officers in their department and of the minor employees, especially those with technical education, upon whom they must draw for the subordinate supervisory positions.

On many roads it is becoming increasingly difficult to secure men who possess the proper qualifications for advancement. For this reason, at different times various plans for the special training of men in the maintenance department have been developed and tried, but for various reasons most of them have been allowed to lapse. For several years the Pennsylvania and the Delaware & Hudson have been the only roads that have followed a definite plan that has for its immediate objective the training of men for supervisory positions in the maintenance department and in its larger implications the continued preparation for advancement in other lines of railway operation. It is the experience of these roads that their men are not only well fitted for the handling of their immediate work, but that other departments draw on them frequently for men who are qualified for positions of responsibility.

Another interesting experiment in training has been undertaken recently on a Middle-Western road. This plan provides that each month the chief engineer shall send to division engineers and to supervisors of track and of bridges and buildings a series of questions relating to various phases of and practices in maintenance. They are required to make a study of each of the included

subjects and write comprehensive answers to each of the questions.

As the answers are received they are assembled and forwarded to one of the executive officers who assigns them to a member of his staff who is experienced in maintenance. He examines them critically, after which the answers, together with the critical comments, are returned to this officer. If any of them are not satisfactory, they are returned to the writer with instructions to make a further study and prepare another answer.

While this plan has been in effect for a relatively short time, so that a final opinion as to its merits cannot be given, the officers of this road can see a noticeable improvement in the quality of the answers that are being submitted. They also find that the division officers are more alert and observant and that they are making more detailed studies of the work that they are doing, particularly of the reasons for certain methods and the results that they are obtaining from them.

ECONOMY

How the Section Forces Can Promote It

AT THIS time when the railways are scrutinizing every item of maintenance expense, what can the section forces do to promote economy in their work? This is a question which should be given thoughtful study by every supervisor and foreman. Those who are alert will find a number of ways in which the answer can be given.

As an example, while an adequate complement of usable tools should be kept on every section, a searching examination should be made to insure that a surplus is not being carried that will remain idle. In the same way supplies of materials should be checked to ascertain if they will be used and care exercised to apply them in a systematic manner that will insure the best results from their use. Materials and tools that cannot be used within a reasonable time are a liability rather than an asset, furthermore, other sections may be short of the very material that is thus lying idle elsewhere, which is an added liability, especially if it is needed badly. Scrap is a total loss unless it is picked up and shipped to the points of concentration.

When work is done it should be done thoroughly and the causes of defective conditions removed, if possible. Temporary repairs, if made a regular practice, lead to tinkering and result in men going from point to point to do work over and over again, with the consequence that most of the effort so expended is lost, since it is not expended in constructive work.

A fundamental requirement in handling section work economically is a program which is adhered to as closely as the exigencies of a section foreman's duties will permit. Economy does not mean penurious spending, but the intelligent and careful application of labor and materials to produce the best results. Working consistently to a program and getting the best results from the labor and materials available require organization, management and alert observation, so that the economy which foremen and supervisors attain in their work is a measure of their ability along these important lines.

Only a few items have been mentioned as illustrations, which may seem unimportant, if considered from the standpoint of a single section. But the matter cannot be viewed from that basis. What is done on the individual section is multiplied by the number of sections on a railway, and a small saving on every section will give a surprisingly large aggregate for the railway as a whole.

There is always an opportunity for foremen to exercise their talents to promote economy, but the need for doing so is more obvious during periods of light traffic when expenditures are being scanned more closely. At this time both supervisors and foremen should take advantage of the opportunity that is afforded them to tie up their loose ends, eliminate lost motion and perfect their practices and organization to enable them to do better work with greater economy under the more favorable conditions that it is hoped are just ahead.

A BALLAST PLAN

Great Northern Realizes on Ballast Deposits

FOUR items go to make up the primary elements in the success of the Great Northern's plan of conducting its ballasting operations that are described on page 540 of this issue. Foremost among these is the natural advantage of a favorable distribution of gravel deposits, a large portion of the lines being in glacial drift country. To realize fully on this distinct advantage many gravel pits have been opened—more, in fact, than can be operated profitably for extended periods in any one year. As a result rail haul from pit to track has been reduced to a practical minimum.

Another important element is the use of crawler-mounted shovels, a type of machine which is so much more mobile than railroad-mounted equipment that the need for a spotting engine and crew has been eliminated. The shovel moves along the empty cars set out in the pit, loading them one at a time. But to carry this plan to its logical conclusion there has been added the further feature of a seasonal plan which not only embraces a scheduling of the operations of the pits with the programming of the ballasting, but which also covers a detailed scheduling of all the work equipment from week to week during the season.

It is not to be inferred that the features of this plan are peculiar to the ballast work of the Great Northern. All of them will be found in effect to a greater or less extent on other roads. What is significant about the plan is that this railroad has endeavored to realize to the fullest extent the natural advantages which it enjoys, and as a consequence its operations comprise an object lesson in efficient methods.

It is also of interest to observe that despite the high quality of the natural ballast available for general use, the Great Northern has found that for main line purposes prepared ballast, in spite of its greater cost per yard, makes for lower maintenance costs on heavy-traffic main-line tracks. The practice of this railway in this regard may well be given careful consideration by those who are studying proper balance in track design.

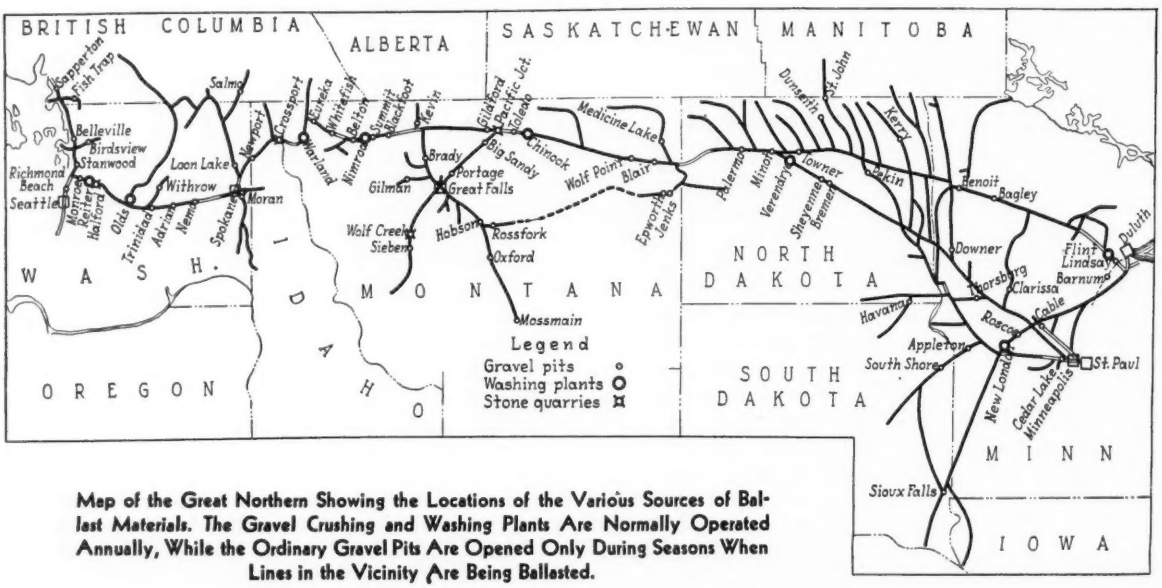
Meeting the Ballast Requirements of the Great Northern

Typical Three-Man Operation of a Gravel Pit

THE thorough co-ordination of the working of 21 gravel pits and 8 crushing and washing plants with the annual ballasting schedule, and the conduct of pit operations with a minimum force, are distinctive features of a carefully studied plan followed by the Great Northern to meet its ballast requirements. This road applies annually about 500,000 cu. yd. of gravel ballast, of which about 200,000 cu. yd. is washed and crushed gravel prepared at the eight plants and the remaining 300,000 cu. yd. is pit-run gravel excavated from some 21 deposits. The sources of gravel ballast have been developed at various places over the extended mileage of the railway with a view to effecting a compromise between the conflicting considerations of the quality and quantity available, on the one hand, and the length of haul on the other. In the distribution of the ballast from the pits now being worked, the average haul is about 95 miles.

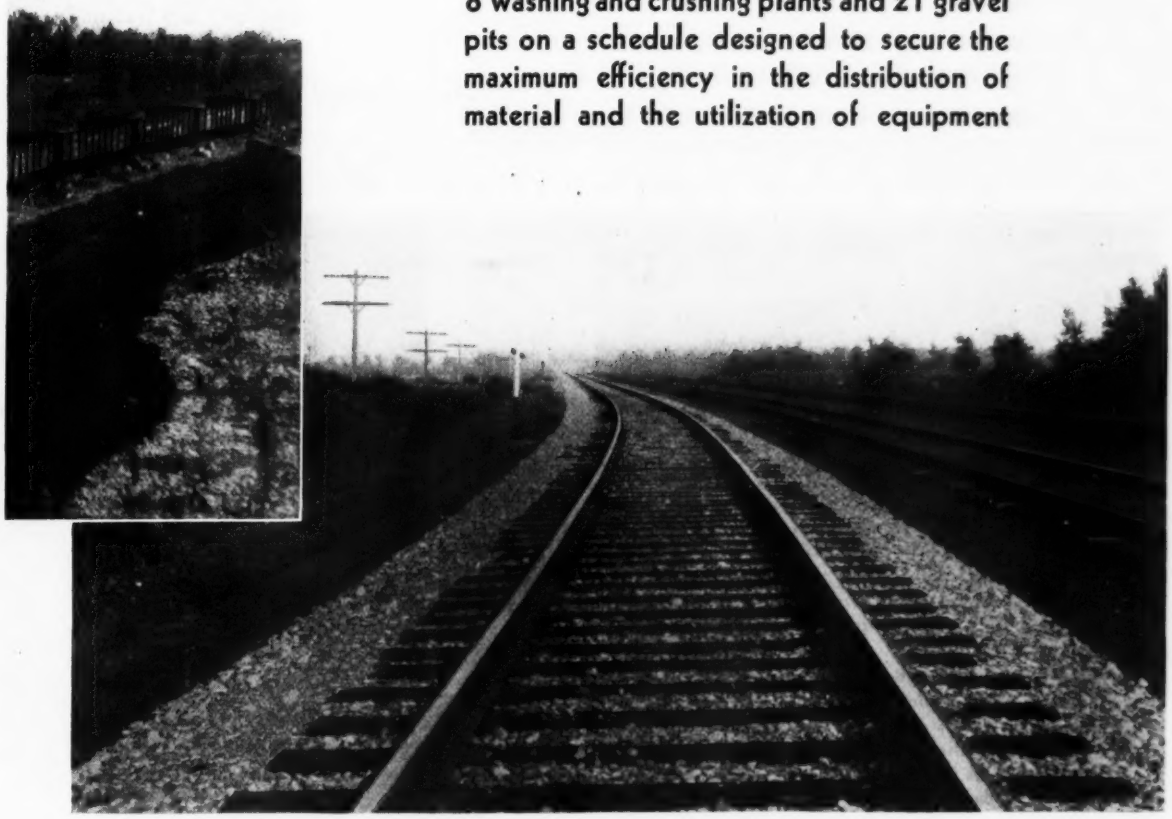
Pit-run gravel has been used for ballast on the Great Northern for many years, but in recent times the ballasting of main lines with washed and crushed gravel has been carried out under a program that has concentrated attention, first to the heavy traffic lines, but is being extended to other main lines as well and provides for the eventual surfacing of all main lines with the prepared ballast within a limited period. Eight pits, equipped with washing and crushing plants, are now operated each working season. These are located at Flint (Brookston) and New London, Minn., Verendrye, N. D., Nimrod, Chinook and Warland, Mont., and Reiter and Olds, Wash.

These ballast plants are operated for a large part of each season, whereas the 21 other pits from which gravel is taken are worked only as it is necessary to supply ballast to the lines that are tributary to each of them from the standpoint of reasonable length of haul. In general, each pit is opened only every second year and, when worked, some of these plants may be operated continuously for as long as ten weeks while others may be active for only two or three weeks. To conduct these operations with the fewest units of equipment calls for the preparation of a carefully drawn schedule that must take into account not only the equipment requirements of the pits, the cars needed in hauling service and the ballasting programs of the various lines, but also, because much of the same character of equipment can be employed in



Map of the Great Northern Showing the Locations of the Various Sources of Ballast Materials. The Gravel Crushing and Washing Plants Are Normally Operated Annually, While the Ordinary Gravel Pits Are Opened Only During Seasons When Lines in the Vicinity Are Being Ballasted.

Plan of operation involves the working of 8 washing and crushing plants and 21 gravel pits on a schedule designed to secure the maximum efficiency in the distribution of material and the utilization of equipment



Main-Line Track Ballasted with Crushed and Washed Gravel

ditching, bank widening, etc., must include the program for such work as well.

An idea of the task involved is indicated by the fact that a typical schedule for ballasting and allied work, covering the 8,366 miles of lines of the Great Northern during the active season, involves the distribution of 13 power shovels, 8 Lidgerwoods, 14 ballast plows, 31 dozers, 450 ballast cars and 500 general service cars.

A Small Force

The distinctive feature of the operation of the pits from which gravel is taken without washing or crushing is the small working force. By using shovels with crawler treads, spotting of the cars becomes unnecessary; consequently the pit crew is confined to the men necessary to operate the shovels. The manner of operating these pits may be illustrated by describing a typical pit in detail, namely the pit at Thorsborg, Minn. This pit has a 40-ft. face about a mile long and is provided with a loading track that will hold 100 cars and a supplementary track laid some distance back from the face, on which a 12,000-gal. water car is spotted. From this car a two-inch pipe is laid to the loading track and extended along the ends of the ties of this track for its entire length. At intervals of 128 ft. tees are introduced in this pipe, with short nipples for connections for gate valves and standard air hose. These provide convenient water-supply connections for a hose carried on the shovel.

The machine operated in this pit is a Marion 37, 70-ton oil-fired steam shovel on crawler treads, and provided with a two-yard dipper. It is equipped with two 480-gal. tanks, one for oil and the other for water, and consumes 250 gal. of oil and 4,000 gal. of water in loading about 1,500 cu. yd. of gravel in a 10-hour day. The shovel carries enough hose to reach one of the outlets in the water pipe from any position along the face of the pit and, as the water line enters the body of the machine through the center pin of the turntable, water may be taken without suspending operation.

General service cars of 100,000-lb. capacity and Hart ballast cars are used in hauling the ballast. They are usually "pulled" and "respotted" during the night, and when the empties are reset, the oil tank car, which stays in the pit until empty, is always placed at the end of the spot nearest the position of the shovel, so that the oil storage tank on the shovel can be refilled, if necessary at the beginning of the day's work.

Position of the Track

When commencing operation in the pit with a shovel of the type mentioned, the loading track is thrown to within 27 ft. of the toe of the slope although it is possible for the shovel to work with the track 12 ft. farther away. However, as the reach is increased, the efficiency of the shovel decreases, so that a track gang is brought in from time to time, to throw the track in. With the

long working face, it is not necessary to do this often. Occasionally the track is shifted by the shovel with the use of a chain.

The working force consists of a crane operator, a fireman and a laborer. The latter inspects the cars, winds up the doors, handles the water hose and does such other work as is required of him. The crane operator stays with his machine during the entire season, moving with it from one assignment to another, and the schedule for overhauling during the idle season is based largely on his recommendations. To carry this plan still further, it is customary to have the operator assist in making the repairs in the shop each winter before the working season opens. This arrangement has produced excellent results; the machines get better attention in the shop and more conscientious care in the field because of the greater personal interest on the part of the operator. The machine referred to above, for example, lost only 1½-hours' time in five months that could be charged to mechanical defects.

As the equipment schedule involves considerable moving of the shovels, facilities are provided for their ready loading and shipment. This includes, in general, a 50-ft. 100,000-lb. capacity steel-underframe flat car on which a special floor is installed, consisting of 8-in. by 16-in. stringers, 11½ ft. long, laid crosswise. In addition, a second flat car is provided to carry the necessary stringers and blocking for the runway required for loading and unloading the shovel, these two cars remaining with the shovel during the entire season.

Views in a Typical Gravel Pit (Thorsborg, Minn.): (1) The Water Car; (2) A Hose Coupling on the Water Pipe Line Along the Loading Track; (3) A Typical Set-Up, with an Oil Tank Car at One End; (4) The Flat Car Used to Transport the Shovel Stays with it Throughout the Season.

Kind of Equipment	Number	Present Location	Dates Equipment 2/19 to 3/12	3/12 to 3/20	3/20 to 4/1	to 4/1 to 4/4	Work and 4/6 to 4/9	4/10 to 4/15	Location 4/15 to 5/7	5/7 to 5/15
Shovel	X-1804	Hillyard	-	-	-	-	-	Flint	F.	F.
"	X-1861	Superior	-	-	-	Lindsay	L.	L.	L.	L.
"	X-1900	Dale Street	-	-	-	-	-	N.London	N.L.	N.L.
"	X-1862	Grand Forks	-	-	-	-	Minot	Division	Cuts	Verendrye
"	X-1898	Delta	-	-	-	-	N.Lake	N.L.	N.L.	N.L.
Ditcher	X-1795	Havre	-	-	Blackfoot	B.	B.	B.	-	-
Ridgerwood	X-1839	Grand Forks	-	-	-	-	-	Flint	F.	F.
"	X-1837	St. Cloud	-	-	-	-	-	-	-	-
"	X-1838	St. Cloud	-	-	-	-	Cuts	Minot	Division	Verendrye
"	X-1842	Havre	-	-	-	Chinook	C.	C.	C.	C.
Plows	R-30,L-35	St. Cloud	-	-	-	-	-	Flint	F.	F.
"	R-34,L-35	St. Cloud	-	-	-	-	-	-	-	-
"	R-26,L-29	Havre-Whitefish	-	-	-	-	Cuts	Minot	Division	Verendrye
Dozers	X-1688	Superior	-	-	-	-	-	Flint	F.	F.
"	X-1796	-	-	-	-	Lindsey	L.	L.	L.	L.
"	X-1830	-	-	-	-	-	Kelly	Lake	N.L.	N.L.
Equipment Unassigned										
Shovels			1904	1904	1904	1904	1904	-	-	-
			1861	1861	1861	-	-	-	-	-
			1900	1900	1900	1900	1900	-	-	-
			1862	1862	1862	1862	-	-	-	-
			1898	1898	1898	1898	-	-	-	-
			1883	1883	1883	-	-	-	-	-
Ridgerwoods			1839	1839	1839	1839	1839	-	-	-
			1837	1837	1837	1837	1837	1837	1837	1837
			1838	1838	1838	1838	-	-	-	-
			1842	1842	1842	-	-	-	-	-
Plows			R30,L35	30-35	30-35	30-35	R30,L35	-	-	-
			R34,L33	34-33	34-33	34-33	34-33	34-33	34-33	34-33
			R26,L29	26-29	26-29	26-29	-	-	-	-

Part of a Schedule Sheet for the Allocation of Work Equipment

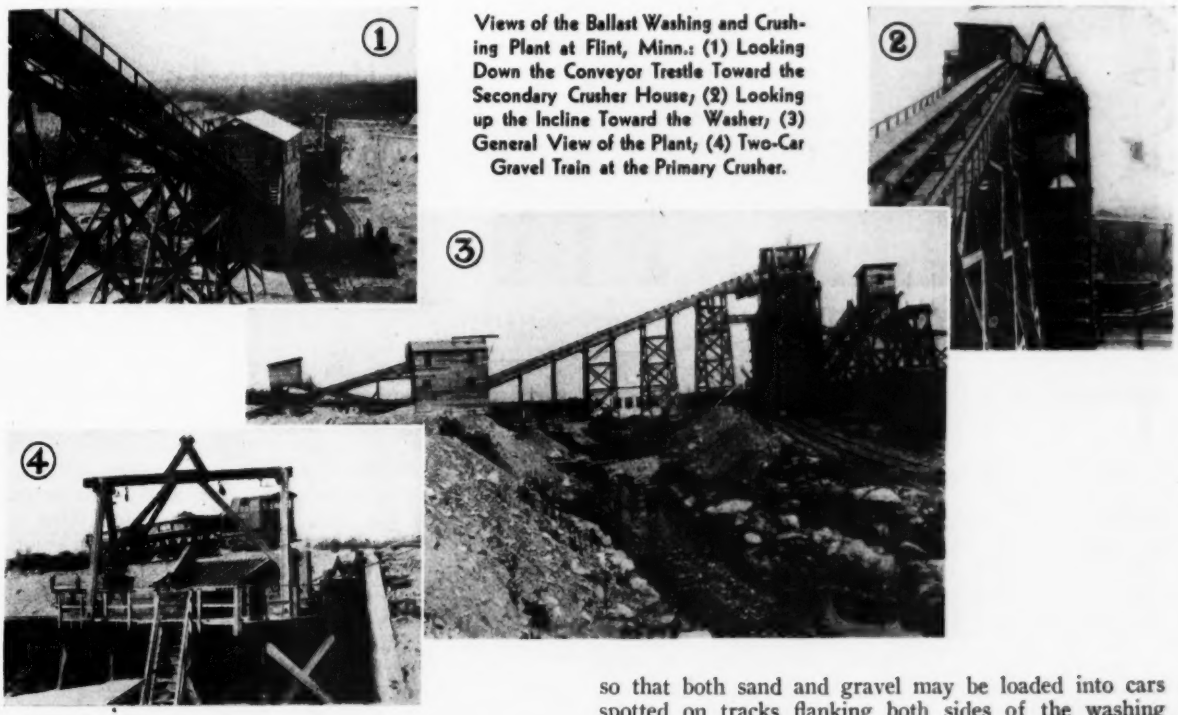
The Crushing and Washing Plant at Flint

The Flint gravel washing and crushing plant, located about one mile east of Brookston, Minn., is typical of the plants of this type operated by the Great Northern. The pit at this location has a face from 15 to 40 ft. high for a length of about 4,000 ft. The soil covering is thin and because of the washing operation, no stripping is normally done.

The excavating is done with a gasoline-operated Erie shovel on crawler treads and equipped with a one-yard dipper. The gravel is loaded into six-yard Koppel cars operated on a 36-in. gage track, in two trains of three or four cars each, by gasoline locomotives. A passing track placed outside the loading track opposite the point where the shovel is working, and connecting with it by means of spring switches, permits the empty train to come into the loading track behind the loaded train and insures continuous operation of the shovel during the switching operation.

The washing and crushing plant consists of three units, a primary crusher, a secondary crusher and the washer, connected by a belt conveyor supported by a trestle constructed on a steep grade. To facilitate delivery to the primary crusher which has been set into the face of the pit at the foot of the conveyor incline to the washer plant, the loading track has been carried up on an easy grade to a point directly over the crusher where the cars are dumped on a grizzly constructed of rails spaced five inches clear. All material passing the grizzly drops on the main conveyor belt, while all stones that

are retained on it go into the crusher which is a 20-in. Superior-McCully machine manufactured by Allis-Chalmers Manufacturing Company, Milwaukee, Wis. The product of the crusher is also delivered to the main belt mentioned above, which is a six-ply, 30-in. belt covered with ⅛ in. of rubber on both sides. This belt delivers the material up an incline to the upper story of a frame building where it passes in turn through a 2½-in. and a 2-in. rotary screen. All particles that pass these screens are delivered to a belt that carries them up a long incline to the top of the washer plant, while all stones retained on the screen are passed through a Symons cone crusher, the product of which is carried back on a secondary belt and again dropped on to the main belt whence it passes again through the 2½-in. and 2-in. screens.



Views of the Ballast Washing and Crushing Plant at Flint, Minn.: (1) Looking Down the Conveyor Trestle Toward the Secondary Crusher House; (2) Looking up the Incline Toward the Washer; (3) General View of the Plant; (4) Two-Car Gravel Train at the Primary Crusher.

The Washer

At the top of the washer the crushed gravel is dumped into the scrubber, a 6-ft. cylinder about 12 ft. long, into which 1,200 gal. of water is discharged per minute. This thoroughly agitates the material and breaks up the lumps of clay and loam so that this fine material is held in suspension by the water as it leaves the scrubber. The stream of water and gravel is discharged into a conical screen with 1¼-in. holes and all particles held on the screen pass into a second conical screen with 5/16-in. holes. All material passing the 1¼-in. screen and all particles held on the 5/16-in. screen (in other words, the ballast material) is discharged into the log washer, a deep rectangular water-tight tank, from which the submerged ballast is removed by a bucket conveyor and dumped into the gravel bins. The water flows out of this tank at the top and thus carries away twigs, chips, grass and any other matter that will float.

The material passing the 5/16-in. screen, namely, the sand, flows along a steel-lined chute to two Shaw sand classifiers placed in tandem. These consist of chutes mounted over tanks of clean water which are so arranged that the tanks are overflowing into the chutes through holes in the floors of the chutes. This upward flow of water is sufficient to keep suspended matter from dropping into the tanks, but does not prevent the particles of sand that roll along the floor of the chute from falling through the holes into the tank. When the load of sand in these tanks attains a predetermined weight, a valve in the bottom opens and allows the sand to drop into the sand bin.

There are two gravel bins and one sand bin with their bottoms above car level. They have chutes on both sides so that both sand and gravel may be loaded into cars spotted on tracks flanking both sides of the washing plant. Each of these bins has a capacity of 100 cu. yd. above the chutes.

All operations in the crushing and washing plant are actuated by electric motors using 440 volt alternating current supplied by a generating plant housed in a steel building. This consists of a 360-hp. Fairbanks-Morse six-cylinder Diesel engine direct-connected to a 300-kv.a. generator of the same make, which produces 3-phase, 60-cycle alternating current at 2,300 volts. This is stepped down to 440 volts in a transformer at the plant. The power plant equipment also includes a three-horsepower, Type-Y, Fairbanks-Morse gasoline engine which drives a small air compressor for starting the Diesel engine and a 10,000-gal. tank for the storage of distillate oil. The washing operations require the use of 2,400 gal. of water per minute, which is taken from the St. Louis river which flows close by. An Allis-Chalmers centrifugal pump driven by a 75-hp. motor delivers water to the plant through a 12-in. pipe which is divided into two 8-in. lines, one of which carries water to the scrubber and the other to the washers.

Under normal operation this plant handles 800 cu. yd. of material from the pit in a 10-hour day and this produces from 600 to 650 cu. yd. of usable product, of which about 70 per cent is gravel and 30 per cent is sand.

In addition to its use for ballast, the gravel from the washing and crushing plants is used as concrete aggre-

(Continued on page 550)

Saving Half a Million Dollars Annually

How one road is reducing costs and improving maintenance by carefully programming its bridge and building work

Building Gangs Complete All Work as They Go

THROUGH drastic changes which it is making in the methods of maintaining the bridges and buildings on its lines, the Chicago, Milwaukee, St. Paul & Pacific has already effected savings which approximate half a million dollars a year, despite the fact that these methods have not yet been applied to all divisions, nor are they yet in effect for all classes of work on any division. There is every reason to believe, therefore, that when the plan is fully effective, still greater savings will be realized.

Not the least interesting feature of the new method is the fact that, despite the large reductions in costs that have been shown, every division upon which the plan is being followed has done a greater amount of constructive work and applied more material in maintenance during the year than in any similar period before the plan was adopted. Of equal interest is the fact that this plan is so simple that it can be put into effect on any division without disturbing the existing organization and without reference to the methods employed on adjoining divisions, although, to be successful, it must have the co-operation of all of the division officers involved.

This simplicity of the plan, combined with the fact that its application to any division does not affect the operations on adjoining divisions, has made it possible to apply it progressively to a limited number of divisions each year. After the division forces have been thoroughly instructed in the details of the methods, so that they understand the requirements and have their work properly organized, they are able to follow the plan in its entirety with a minimum of supervision from the general officers.

Purpose of the Plan

Basically, the plan aims to control the expenditures for maintaining the bridges and buildings for the railway as a whole, as well as on the individual divisions. As the plan has been developed, it has been found that through the methods employed it is also possible to maintain control of the productive results of the labor engaged on this type of work and that almost invariably better work has been done than under the old methods. This result has been attained in large part through the elimination of unproductive time in the individual gangs by eliminating lost motion in their work. Under the methods which are followed, the unit forces, that is, the size of the individual gangs or the number of gangs, are not increased, but a better balance is maintained with reference to the size of the gangs for the tasks that are to be performed, as well as in the internal organization of each gang. When the new methods are to be introduced on any division, a careful study is made of all of the conditions of the work and of the force involved, and the number and size of the gangs, that is, the total man-power to be employed, are adjusted to the amount and character of the work that is to be performed.

How the Plan Originated

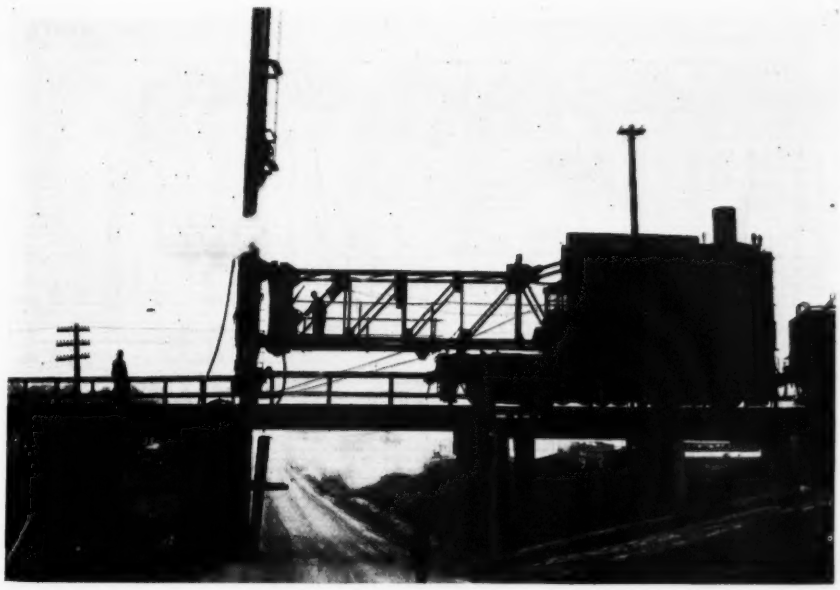
The inception of the plan came about through the curiosity of the chief carpenter on one of the divisions of the road as to the number of man-hours required to do certain classes of bridge work. Keeping a record of the performance of all of the gangs under his jurisdiction, he noted a wide difference in the man-hour performance of different foremen engaged in exactly similar work. He also discovered that a large amount of unproductive time was consumed in moving from one job to another, while considerable time was being lost because of failure to receive delivery of materials when needed.

Investigation developed, however, that most of the responsibility for the poor deliveries of materials rested upon the division and not upon the stores department. The reason for this was that the division officers were not properly anticipating their requirements, but were ordering small lots of mixed lumber and structural timbers, as well as other needed supplies, from time to time as necessity arose, at the same time asking for quick delivery. Since the stores department had no advance notice of these requirements, it was often necessary to make these small purchases after the requisitions were

received, thus adding to the cost as well as to the time required to deliver material to the division.

Considerable time was also being lost from productive employment through the practice of the division transportation officers calling on the bridge and building forces, from time to time, to drop whatever work they were doing and engage at once upon some "hurry-up" job of alteration or extension to an existing facility, or the construction of a new facility to meet some changed condition of operation or traffic. These breaks in the regular order of their work often resulted in an excessive loss of productive time, because of the necessity of moving the outfits and assembling material for jobs that had not been anticipated.

During the period that these records were kept, a classification was made of the different types of bridge work, and a tentative determination was made of the number of man-hours required to apply 1,000 ft. b.m. of timber or one lineal foot of piling in each of these classifications. A plan was also formulated for eliminating the unproductive time by eliminating its causes, and for putting the man-hour performance of the several gangs on an equable basis. This plan contemplated a uniform amount of work for each of the gangs. When the plan was tried out, the results in reduced costs, more orderly and better maintenance, and the increased amount of productive work were so outstanding that arrangements were made to extend it to other divisions.



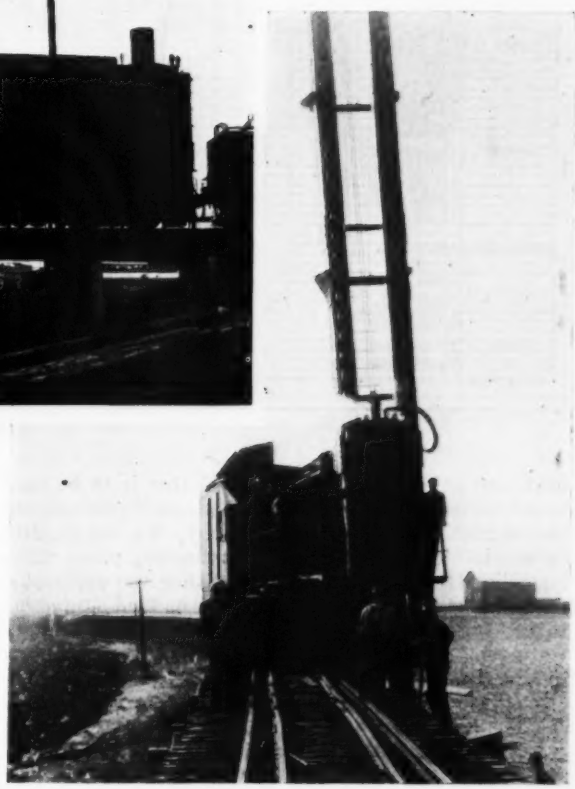
Pile Drivers Are Equipped with Steam Pile Hammers

What the Plan Is

A fundamental requirement of the plan is a careful inspection of all of the structures on the division, including both bridges and buildings. It is imperative that this shall be done early enough in the year to permit the preparation of any plans that are necessary, a complete bill of materials for each structure and the classification of the work that will be performed. In practice, the inspection is made by the division engineer and the chief carpenter, beginning about May 1, and a report is sent to the general supervisor of bridges and buildings not later than June 15.

As a part of the inspection, a study is made of such structures as stock yards, loading platforms and other facilities, to determine whether changed traffic conditions make it practicable to reduce their size. As a result of these studies, it has been found possible in some instances to make marked reductions in the cost of maintaining individual structures, particularly where their condition requires complete renewal.

As submitted, the report, in which bridges and buildings are segregated, is in the form of a work sheet which includes complete descriptions of the individual structures, a statement of the condition of each, the work that is recommended, and a detailed bill of the material that will be required. As soon as it is received, the bridge report is checked against the bridge record with respect to the description and the age of the several structures listed. For the time being and for reasons that will be explained, the discussion will be confined to the maintenance of timber trestles.



Redriving a Long Trestle

This comparison with the bridge record is made to determine the advisability of making extensive repairs that may be recommended for structures that have practically lived their normal life or of renewing them in kind, if renewal is recommended. In making this comparison, notations are also made of items requiring further information, such as drainage areas, the desirability

of substituting permanent structures of steel or concrete, or of constructing pipe or box culverts and filling certain trestles. Recommendations that seem to be out of line are also noted. A list is then made of all these structures, and they are reinspected by the general supervisor of bridges and buildings. There are always a certain number of items that cannot be placed in the established classifications, because they are either of a special character or are too small to permit the application of man-hours to the units of material involved. These are returned to the division engineer for flat estimates of the cost, if these estimates have not already been made.

Schedules Are Prepared

These matters are cleared up as rapidly as possible, the work sheets as revised are approved, and the bills of material are revised to conform to any revisions that may be made of the work that is recommended. The next step is to classify the material that is to be used in the various structures in accordance with the amount and character of the work involved. Typical classifications include unloading timber, unloading piling, driving piling, framing pile bents (including the application of caps and sway bracing), renewal in kind (referring to the renewal of an entire trestle), renewal of floor (stringers, ties and guard rails on pile trestles), renewal of the timber deck on steel spans, general repairs, strengthening pile trestles, removal of stringers from filled trestles, repairing pipe culverts, unloading and placing pipe for culverts, etc.

Calculations Are Simple

As soon as these classifications and the computation of the total amount of material in each classification are completed, the number of man-hours required for each unit of material in each classification is applied to obtain the total man-hours that should be necessary to complete the work outlined for each structure. Although this seems to be rather complicated, in reality the calculations are simple and can be made quickly. From these data a typewritten schedule is prepared for each division, showing the bridge numbers, the character of work to be done, the man-hours involved, the size of the gangs to be employed, the date of starting the work on each structure, the total time required to do the work, and the date of completion. When several bridges are close together and the work required on each is small, they may be combined so that the schedule covers the group instead of each structure separately.

A chart is also prepared for each division, which shows by months and districts but not by structures, the total amount of material that each gang is scheduled to apply in each classification. It also shows the monthly and annual pay roll of the bridge and building forces for the preceding two years, while the current pay roll is filled in at the end of each month and at the end of the year. Space is provided for the estimated total number of man-hours and the total volume of material for each gang and for each classification; also for the amounts of each of these items for the current month and for the cumulative totals. The chart enables both division and general officers to keep themselves informed currently of the progress that is being made, and of the fidelity with which the man-hour schedule is being followed by each of the gangs.

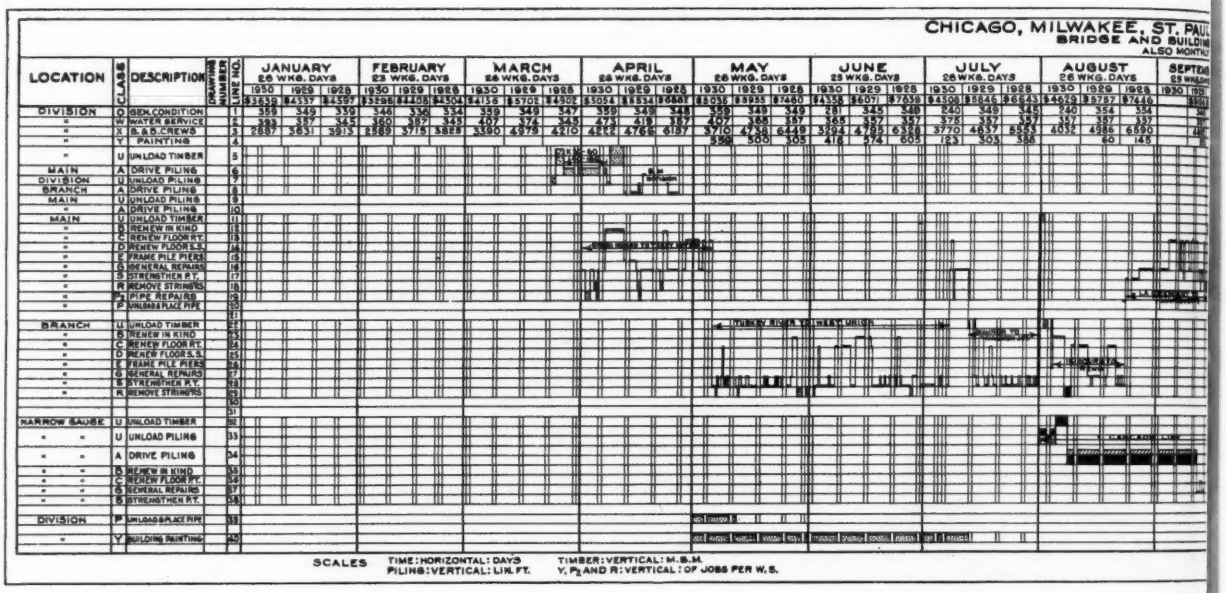


Chart Showing Diagrammatically the Schedule for a

Material Is Ordered Early

As soon as final approval of the program is given, which is not later than early in the fall, the chart, the typewritten schedule and a copy of the revised work sheet are sent to the chief carpenter of each division, who makes requisitions for all materials that will be required for the ensuing year. These requisitions specify the time and the place of the deliveries that will be necessary to meet the requirements of the schedule, an important feature of the plan being that these deliveries shall be made at approximately 60-day intervals, and shall include every item that will be required during the ensuing period. If, for any reason, progress is retarded or accelerated after the first delivery is made, the stores department is notified to set back or advance the date of subsequent deliveries to conform to the rate.

at which the program is progressing.

These shipments are made in one lot and with the exception of hardware, which is stored in the gang supply cars, are distributed to the points of use by the gangs that are to apply them. A gang then starts at the end of its district and completes all work as it advances.

Bridge and Buildings Gangs Are Distinct

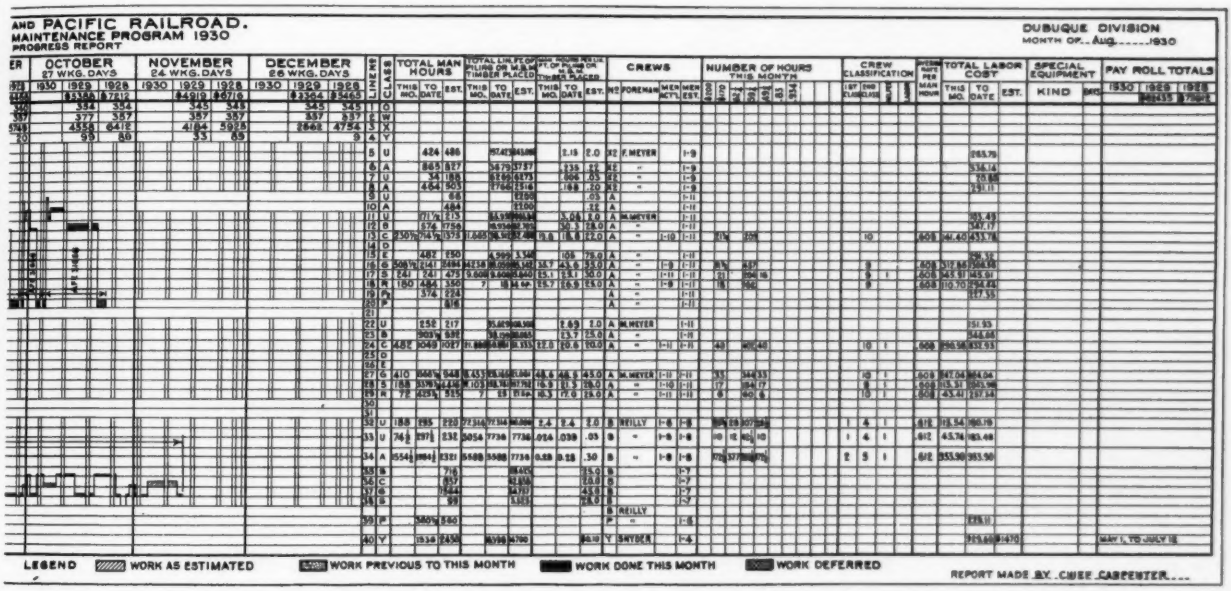
Bridge gangs are kept separate from building gangs and neither is permitted to do the work of the other, except in special cases. Bridge work differs radically from building work, the economical size of the gangs is different, while a good bridge carpenter is not necessarily a good house carpenter. Many building jobs can be done by one or two men, so that if done by bridge men or by combination gangs, the gang organization is disturbed constantly, and more or less confusion results from changing from one class of work to another, so that production is definitely reduced. It has been determined in practice that it is more economical to make this distinction, since a greater production per man-hour is obtained where the work is not mixed.

With the exception of pile driving, painting and the placing of concrete pipe, the entire maintenance operation is carried out by permanently assigned division gangs. If work is light on one division and heavy on another, however, gangs may be moved temporarily to help out, but this contingency is definitely provided for in the schedule.

Driving Piles

Two separate pile-driving gangs, which employ self-propelled pile drivers that are equipped with steam pile hammers, drive all of the piles called for on the work sheets, advancing regularly from division to division in accordance with a schedule similar to that prepared for the division gangs. If the pile-driving schedule will retard the work on any division, as happens occasionally, an extra driver is sent to that division and the driving that is necessary to avoid delay is done by one of the division gangs, but provision for this is also included in the schedule. These modern drivers replace 12 older outfits of the drop-hammer type, the best of which were overhauled and are held in reserve for driving piles which cannot be covered by the system pile-driving schedule without adverse effect upon the division maintenance program.

Similar methods are employed in the inspection of buildings and in the preparation of the season's program for maintaining these structures. The forms used in preparing this program are different, however, owing to the larger number of classifications that are necessary and the wider diversity of the materials that are applied. In the building field there is also a greater number of small jobs to which it is not practicable to apply the unit man-hour system. An example of this is the replacement or the renailing of a few slates in a roof or the resurfacing of a small spot in a brick platform. The division officers are expected to submit a flat estimate of the cost of such jobs, but include any material that is required in their bill of materials.



Year and the Program of the Work on one Division

Building material is ordered in the same way and at the same time as the bridge material, and the same system of deliveries is followed. Bulky material is distributed at the point of use, but the smaller items are carried in the gang supply cars to avoid possibility of loss. These gangs also start at one end of a district and advance progressively, completing all scheduled jobs as they proceed, but do no other work without first obtaining special permission.

Maintenance Shop Facilitates Work

A central shop which serves all subdivisions of the maintenance department is maintained at Tomah, Wis., in which special and standard items of mill work and other construction used in building work are made, such as stock-yard gates, wooden water tanks, small lots of special mill work, special concrete forms, concrete hog troughs and numerous other items. This shop constructs small buildings, such as crossing watchmen's or switch tenders' shanties, and ships them ready for use, and does other work of a similar character that can be done more economically at a central point than in the field. Pre-

cast concrete bridge slabs are also manufactured here, while standard floor material—ties, guard rails and tie spacers—for steel spans is preframed. It is a matter of experience that this shop greatly facilitates the work of both the bridge and building gangs, while the economy of the work that it does is assured by the requirement that it must compete with commercial mill-work companies on all jobs of any magnitude.

Method of Painting

Painting is scheduled in accordance with the system already described and the painting of both bridges and buildings is done by gangs that move progressively from division to division in accordance with the schedule.

Estimate and Schedule of Work to be Done by B. & B.
Forces on Dubuque Division 1930

Unload Piling and Timber Marquette to Green Island (1-9)

Unload Piling			
3,469 lin. ft. @ 0.03	Time Required 1.3 days	Date 3/24	-3/25.3
Unload Timber			
80,000 M.B.M. @ 2.0	2.0 days	3/25.3	-3/27.3
Drive Piling Green Island to Turkey River -			
K-30 - 160 lin. ft.			
K-50 - 2,933 lin. ft.			
K-140 - 216 lin. ft.			
K-166 - 160 lin. ft.			
3,469 lin. ft.	9.54 days		
K-1514- 286 lin. ft. @ 0.03			-5/3.48
	days	5/3.48	-5/6.09

...pply Timber Turkey River to West Union (1-11)

K-1164 - S - 4.090			
K-1170 - S - 1.705			
5.795 @ 28	1.70 days	5/24.47	-5/27.17
K-1170 - G - 0.168 Mbm @ 45	0.10 days	5/27.17	-5/27.27
K-1172 - B - 5.263 @ 25	1.40 days	5/27.27	-5/28.67
K-1174 - R - 10 spans @ 25	2.60 days	5/28.67	-6/2.27
K-1174 - S - 2.728 @ 28	0.80 days	6/2.27	-6/3.07
K-1178 M.L. - C - 0.949			
K-1178 S.T. - C - 1.149			
2.098 @ 20	0.44 days	6/3.07	-6/3.51

Sample of Typewritten Schedule for Driving Piles and Applying Bridge Timber

The paint for each division is ordered by the chief carpenter at the time he makes the remainder of his requisitions, delivery being made to meet the painting schedule.

The painting of bridges and of buildings is considered as distinctly different in character, so that the two are never done by the same gangs. An exception is made, however, in the case of minor work on isolated structures, where no similar painting is required in the vicinity. Thus a building paint gang, or even a bridge-repair gang, may touch up the paint on a steel bridge. Under the same circumstances, a gang of bridge painters or of house carpenters may be required to handle a minor job of building painting.

All building-painting gangs are equipped with spray-painting outfits, but this equipment has not yet been used in the painting of bridges. The repainting of large bridges is usually done by contract, provided the competitive prices are comparable to the costs of painting with company forces.

A single division seldom has sufficient pipe culvert work to warrant the organization of a special gang or to justify the assignment of the power equipment necessary to handle it. For this reason, all pipe culvert work is scheduled and carried out by floating gangs which also move from division to division as the program progresses. Pipe deliveries are not made at 60-day intervals, as is done with other materials. On the contrary, these shipments are made currently, the aim being to have them at the point of use a few days in advance of the time they will be needed, to allow for possible delays in transit.

Most of the pipe that is used is required for trestles that are to be filled. A locomotive crane is assigned to each of the pipe-culvert gangs, and where a trestle is to be filled, the pipe is unloaded directly from the cars to its permanent place. If the pipe is to replace an existing culvert, it is unloaded on the site of the work and placed in the usual manner by the gang, which has all of the necessary equipment to do this.

Masonry repair work and moderate-sized masonry construction jobs are provided for in the schedules, but it is the policy to contract the larger jobs of new work which require special equipment for foundation work or the placing of the concrete.

How Gangs Are Equipped

When the season's work is planned, the number and size of the gangs to be employed are specified, as well as the territory each one is to cover. Bridge gangs average from 9 to 11 men; pile-driving gangs, 9 men; building gangs contain 4 to 6 men; and paint gangs consist of a foreman, 2 painters and 2 helpers. If the amount of concrete work to be done is sufficient to justify special concrete gangs, they are organized and are equipped with portable air compressors, gas-driven concrete mixers, paving busters, concrete breakers of sufficient size to permit their use for driving sheet piling, and such other pneumatic tools as they can use. All of the bridge gangs are or will be equipped with power tools, the character of this equipment depending on the kind and amount of work assigned to them. Every gang, however, will include in its equipment power saws and boring tools. Paint gangs engaged in building painting are given spray-painting equipment. Building gangs are not yet equipped with power tools, but serious consideration is being given at this time to the matter of providing them with such equipment.

How the Plan is Administered

After the schedule is approved, it is the duty of the division officers to follow it rigidly, and they are held responsible for the progress and the character of the work that is performed, as well as for seeing that each gang adheres to the man-hour requirements for all classes of work. They cannot take gangs off scheduled work, or men out of these gangs, to perform other work, or increase or decrease the size of any gang without special permission from the general supervisor of bridges and buildings or the engineer maintenance of way, except in emergencies when the continuity of the line or of the movement of traffic is broken or threatened.

In all other respects the gangs are under the full jurisdiction of the division officers. They receive their instructions, are carried on the division pay rolls and are amenable to the same disciplinary rules as before. Pile-driving, pipe-culvert and painting gangs, and repair gangs assigned temporarily from other divisions, report to the chief carpenter of the division upon which they are working, and for the time being become an integral part of the forces of that particular division.

In building work more than any other class of maintenance except that of track, many items of small repairs must be cared for currently, since they cannot wait upon the arrival of the scheduled building gangs. The

plan provides, therefore, for one or two men at important terminals and one or two road carpenters who are assigned to this class of work, and who report directly to the chief carpenter.

In the event that necessity arises for doing work that was not anticipated when the schedules were prepared, the division officers have the option of having it done by local contractors or of securing permission to make a temporary change in the assignment of one or more of the scheduled gangs. Experience has shown that during the first year that the schedules are in effect on a division, the number of such requests is considerably larger than in subsequent years, indicating that division officers are being educated to plan their work more effectively or that they are realizing the magnitude of the expenditures that are sometimes made for work that is not wholly justified.

As soon as the season's program is completed, the main seasonal operation extending from March 1 to December 1, the forces are put on a winter basis. In order that full benefit may be obtained from the plan, the work for the winter is programmed as carefully as for the summer and the same system of control over the forces is effective.

Advantages of the Plan

Practical application of the plan has proved that it has a number of definite advantages over the former methods of maintaining bridges and buildings, and the economies that have been realized are ample confirmation that this is true. It should be understood, however, that the former methods did not differ greatly from, but, in general, were typical of those followed on other roads. In other words, each division was an individual unit which handled its work in its own way, there being no co-ordination of this work for the road as a whole.

The striking disclosure of the investigation that was made to explain the wide variation which existed between gangs in the number of man-hours that were required to do exactly similar work, was the amount of unproductive time put in by practically all of these gangs. This condition resulted partly from the system of having the gangs do both bridge and building work; in large part from the fact that they did not work progressively, but doubled back and forth to do the more important jobs, incidentally often neglecting minor repair work that should have been done; from delay in securing materials; and, not the least important, from the frequent calls to break into the regular order of work to assemble material and do in a hurry work that had not been anticipated.

Unproductive Time Is Eliminated

The principal objective of the plan, therefore, is to eliminate this unproductive time, and this has been accomplished in large measure by the system of programming the work and insisting that the schedules be followed rigidly. The purchasing and stores departments are informed well in advance of material requirements and are thus given an opportunity to buy economically and to make deliveries in an orderly manner. Where the system has been followed, delays due to waiting for material have been practically eliminated. Power tools and equipment can be used to best advantage under this system, and their use is assured for a sufficient time during the year to justify their purchase.

An important advantage that the plan tends to bring about with respect to the division officers is the closer and more intelligent inspection of all of the structures, so that these officers are better informed as to conditions. As a corollary, it has been found that closer and more reliable estimates are being submitted of the work that should be done and of the cost. Another important advantage is the degree to which the plan aids supervision. There are two reasons for this. If an officer is informed in detail of the maintenance needs, what they should cost and the time required to do the work, he is in a better position to supervise the work, while the system of advancing progressively over a given territory simplifies the details of supervision and demands less effort to do it more effectively.

Another result of the application of this system which is noticeable, particularly on those divisions upon which it has been in effect for the longest time, is that the division officers are stimulated to make the best possible use of their resources, so that they are alert to take advantage of every opportunity to increase the amount of productive work of their gangs.

Economic Worth of Gangs Compared

Another benefit that is obvious is that, since the schedule shows exactly what work is to be done, it enables the divisions to organize suitable forces to do it at a time when it can be accomplished most economically. Furthermore, the system of placing a maximum limit on the man-hour requirements for the application of the units of material used in the various classifications, gives a simple but ready comparison of the industrial worth of the different foremen and their gangs, with the result that they are more alert, knowing that the work they are doing is being measured.

A Bridge Gang of 10 Men and a Foreman

It follows logically that, with the elimination of unproductive time, the amount of labor required to accomplish a given amount of work is less. There is no tendency to be niggardly in the allotment of the forces. The number of men in each gang and the number of gangs for each division are calculated on the basis of the maximum number of man-hours required to install the material that must be used to maintain the structures properly. The maintenance work that is to be done and the quantities of material to be used are approved before the allotment of the forces is undertaken. Experience has amply demonstrated that the man-hour allotment in use is fair and can be met by any alert foreman, with only occasional exceptions.

During 1928, a survey was made of the Eastern lines of the Milwaukee, with a view to putting the plan into effect on all divisions. In view of the amount of detail involved in educating the division officers in its application and in organizing the forces, it was decided to introduce it progressively. Accordingly, eight divisions

were selected for its initial trial in 1929. The results were at once apparent and conclusive. Based on the pay roll only, and comparing this year with 1928, which was a typical year, there was a reduction of $100,561 on the scheduled divisions, as compared with an increase of $4,146 on the non-scheduled divisions.

Application Broadened in 1930

Application was made to nine more divisions in 1930, or a total of 17 divisions. Again comparing with 1928, the latest year under the old methods, the pay roll reduction on the scheduled divisions amounted to $422,823, while the non-scheduled divisions showed a reduction of only $37,668 or a total reduction of $460,491. In both 1929 and 1930 there were also definite reductions in work train expense on the scheduled divisions, but the effect on this item can only be estimated.

In considering the results for 1930, it should be borne in mind that the schedules for this year were prepared and approved in 1929, before the present recession in traffic could have been anticipated. These schedules were, therefore, normal and were carried out as approved without change, so that the reductions that were shown in the cost of doing the work were solely the result of the application of the plan, since they were neither arbitrary nor influenced by business conditions. A careful survey was made during 1930, however, to determine what reductions could be made in the schedules, but only a negligible amount of the scheduled work planned for this year was found that could be deferred. Likewise, no arbitrary reductions were made on the non-scheduled divisions. In large part, the reductions on these divisions resulted from preliminary changes made by the local officers preparatory to the introduction of the schedules on their divisions. Schedules for 1931 have been prepared for all divisions east of Mobridge, S. D., and the estimates indicate probable reductions, as compared with 1928, well in excess of half a million dollars.

Details To Be Worked Out

It was mentioned that the plan is not yet fully in effect on any division. The reason for this is that time has not permitted the working out of all of the details in connection with the maintenance of buildings, owing to the large number of classifications involved and the wide diversity of the materials required. These details are being worked out as rapidly as possible and it is expected that the plan can be made fully effective on all divisions in a short time. The basic principles of the building schedules are the same as were described for bridges, the only difference being in some of the details. So far as it has been worked out for buildings it is in effect on all scheduled divisions.

It is the consensus of opinion of those in closest touch with the operation and effects of the plan, that there has been no recession in the character of the maintenance, but rather an improvement. Observation and records both indicate that more constructive work has been accomplished under the new methods and that more material has been applied in work that can be classed specifically as maintenance. The foremen and their gangs, as well as the division officers, are more alert, and there has been a noticeable strengthening of the morale all along the line.

The plan was developed by G. Tornes, now general supervisor of bridges and buildings, Eastern lines, and has been perfected and applied under the general direction of W. H. Penfield, engineer maintenance of way.

Meeting the Ballast Requirements

(Continued from page 543)

gate. The sand is also used for this purpose and for raising subgrade.

The ballast cars are handled and the ballast is unloaded by local freight trains whenever transportation conditions are such as to admit of using these trains to advantage in this service. In other cases, the ballast is delivered to the ballasting operations in work trains of about 30 cars each, the number varying with the grade into the pit, length of haul, etc. Most of the ballast is used in the regular surfacing operations carried out by extra gangs. The usual routine provides that main tracks shall be reballasted with a lift of two to six inches immediately following rail renewals, and occasionally at such other times as conditions may require. Considerable ballast is also required to meet the needs of the district maintenance gangs which carry out a program of light out-of-face surfacing on two miles of each section each year, as described in *Railway Engineering and Maintenance* for March, 1930, page 122.

Ballast Extra Gangs

The extra gangs engaged in ballasting consist of a foreman and 36 men, although when the work is done with a power ballaster two gangs are combined. For hand operation, the organization of the 36-men gang is as follows:

2 flagmen
8 jack men
1 level-board man
4 men spacing ties
6 men renewing ties
5 men filling ahead
8 men tamping
1 camp watchman
1 water boy

These gangs will raise from 800 to 900 ft. of track in a 10-hour day on a busy main line and exceed this average to some extent on lines of lighter traffic. This performance does not include filling, dressing and lining, operations which the gang goes back to complete from time to time.

The organization of two 36-men gangs for work with a Jackson power ballaster is as follows:

2 flagmen
8 jack men
1 level-board man
6 men spacing ties
16 men renewing ties
8 men filling ahead
1 machine operator
2 machine laborers
4 men picking up old ties
20 men filling, dressing and lining
2 water boys
2 camp watchmen

This organization will surface, line and dress an average of 3,000 ft. of track in a 10-hour day.

The district maintenance gangs normally consist of 20 to 25 laborers each and when surfacing track are organized as follows:

1 foreman
4 jack men with 2 jacks
1 level-board man
2 men spacing ties
4 men renewing ties
4 men tamping
2 men filling in
1 machine operator
1 camp watchman
2 flagmen

This gang will raise from 500 to 600 ft. of track per eight-hour day, while actually on surfacing work, as its progress must be interrupted from time to time to do the filling, lining and dressing. In order for the four tamper men to keep up with the gang as organized, they tamp only the ends of the ties and beneath the rails, going back to tamp inside the rails whenever the progress of the gang is delayed, or while the work is being started in the morning before the jack men have had an opportunity to get their work well under way. With this arrangement of the forces the supplemental tamping is also carried on while the remainder of the gang is engaged in dressing track.

Tie Producers Convention Group at the West Baden Hotel, West Baden, Ind.

Crosstie Producers Review Available Supplies

Report greatly curtailed output brought about by reduced demand and falling prices

THAT the railways are facing a shortage of crossties when they return to the market for their normal requirements was indicated by reports presented at the 13th annual convention of the National Association of Railroad Tie Producers at West Baden, Ind., on May 5-7. Not only was it reported there that production had been reduced to the present low level of railway purchases, but the stocks held awaiting sale are also below normal in most of the areas. Since production is now at a low ebb it will require some time before it can be brought up to normal after the roads return to the market. More than 75 officers of tie-producing companies and railway officers interested in the inspection and use of ties were in attendance at the meeting. In the absence of R. C. Hobbs (president, Hobbs-Western Company, St. Louis, Mo.) the sessions were presided over by E. E. Pershall (president, T. J. Moss Tie Company, St. Louis, Mo.).

Activities of the Association

In the review of the year's work, prepared by Mr. Hobbs, attention was called to two activities of special interest to railway men. One related to the appointment of a committee by the association in response to a request from J. M. Kurn, president of the St. Louis-San Francisco, to inspect the track at a point where a passenger train of that railway had been derailed near St. Louis, Mo., in order to determine the accuracy of newspaper reports attributing this accident to bad ties. This committee went over the track in question and examined more than 200 ties closely, as a result of which examination it reported that the newspaper criticism was without foundation. A copy of this report was transmitted to the Interstate Commerce Commission and the report on this accident, issued by that body, contained the statement that "the wreck was not due to bad ties."

The second activity of the association to which Mr. Hobbs referred was the participation by members in the organization in St. Louis, Mo., late in 1930 of the Shippers and Manufacturers Transportation Association for the purpose of making surveys of various modes of transportation, with special reference to the competition of buses and trucks on the highways. To this organization members of the Tie Producers Association have contributed $6,250 to date.

Later in the convention E. E. Pershall described the work of this organization in opposing the operation of buses and trucks in competition with the railways and in promoting legislation to curb them. Largely through the activities of this organization, bills have been introduced in 15 of the southern and southwestern states, designed to curtail the activities of this form of transportation. At the annual dinner on Wednesday night, E. T. Miller, vice-president and general solicitor of the St. Louis-San Francisco, also discussed this subject and presented in greater detail the progress that is being made in the enactment of legislation of this character. Mr. Miller attributed the growth of agitation for legislation to the hostility of the private automobile driver to the usurpation of the highways by the buses and trucks of these transportation agencies.

At the concluding session of the convention, the following officers were elected to direct the work of the Tie Producers Association for the ensuing year: President, E. E. Pershall, president, T. J. Moss Tie Company, St. Louis, Mo.; first vice-president, S. S. Watkins, vice-president, Joyce-Watkins Company, Chicago; second vice-president, B. N. Johnson, B. Johnson & Sons, Richmond, Ind. Roy M. Edmonds, St. Louis, Mo., was re-elected secretary and treasurer. The district directors selected are as follows: Pacific Coast district—E. R. Wade, Charles R. McCormick Lumber Co., Portland, Ore.; North Central district—B. A. Scott, president, Scott Tie Company, Detroit, Mich.; North Eastern district—F. W. Cherrington, Jennison-Wright Company, Toledo, Ohio; South Eastern district—F. P. Dabolt, president, Tennessee Tie Company, Nashville, Tenn.; and South Central district—J. A. Tiller, J. A. Tiller & Son, Little Rock, Ark.

The Convention Program

IN addition to reports from the district directors, the program included six papers presented by railway men on the care and use of crossties and two papers by representatives of the Forest Products Laboratory. In one of the two latter papers, R. D. Garver, senior engineer at Madison, Wis., presented a forecast of the crosstie requirements of the railways of the United States for the next 17 years. Based on the annual tie requirements of 27 railroads for the past 20 years, as compiled by the American Wood-Preservers' Association, which averaged 181 ties per mile in 1928, he assumed a straight line reduction in demand to 104 ties for these roads by 1948. The average requirements of all of the roads at that time is assumed to be 39 ties per mile more, namely, the amount by which the average requirements per mile of all the railways exceeded those of the 27 roads in 1928. Therefore, assuming a demand of 143 ties per mile for renewals, and an average increase per year in the mileage of all tracks of 3000 miles, he concluded that the demand for crossties for both renewals and new tracks in 1948, would be 79,000,000.

The Identification of Fungus in Crossties

The second paper, on the Identification of the Fungi and Stains Which Are Permissible Under the Standard Specifications for Crossties, was a most comprehensive and thorough contribution by C. Audrey Richards, pathologist, Forest Products Laboratory, Madison, Wis. In this paper, Miss Richards attributed decay to the growth of wood-destroying fungi which live on certain constituents of the wood. She pointed out that the conditions under which railway ties are stored and used are frequently ideal for the rapid growth of fungi.

After describing the various types of fungi that attack wood, and indicating the method of their propagation, she dwelt upon the means by which they may be detected in their early stages. Entering timber through wounds caused by broken branches, fire scars, etc., these fungi produce different kinds of rots which may be classified roughly as between white rot and brown rot. Since the typical stages of rot are easily detected, and it is to be expected that no ties are acceptable which contain rot, Miss Richards dwelt upon those indications which enable rot to be detected in its early stages. She then defined and illustrated many of the more common forms of rot in living trees, as well as in ties. Because of its technical character, it is impossible to abstract the report here.

Does Tapping Effect Tie Timber?

By C. S. BURT
Superintendent Ties and Treatment, Illinois Central, Grenada, Miss.

DOES the tapping of pine trees impair the resistance to decay of crossties cut therefrom? During the early years of the industry, timber was bled for four successive seasons but the scarcity of timber and the effect of the "cat-face" or scar on the milling of this timber has brought about a considerable change in this respect in that at present trees are abandoned after being bled two seasons. The turpentine operations are about two years ahead of timber cutting and it is the opinion among mill men that this period is more than sufficient to replenish fully the amount of resin that has been drawn from the timber.

Some of the oldest pine mills in the south which have worked their timber for years, backed by experiments conducted within their own organizations are strong in their conviction that bled timber is on a par in every respect with timber that has not been tapped. It is freely conceded, however, by these concerns that a certain amount of damage or loss occurs from this operation through the production of lower grade material cut just beneath the scars or faces, because of pitchy or very resinous streaks. There are other mills in the same territory with long years of continuous operation which are equally firm in their views that bled timber for use as crossties or structural material has been considerably damaged by being tapped, both as regards to strength and resistance to decay.

The Forest Products Laboratory at Madison, Wis., has conducted many experiments in an attempt to clarify this situation. The following appeared in Forest Circular No. 12, issued in 1906.

"The results prove conclusively (1) that bled timber is as strong as unbled if of the same weight; (2) that the weight and shrinkage of the wood are not affected by bleeding; (3) that bled trees contain practically neither more nor less resin than unbled trees, the loss of resin referring only to the sapwood and therefore, the durability is not affected by the bleeding process."

The Illinois Central has from time to time used a rather large number of untreated heart pine crossties produced from timber that had been tapped. We have given much consideration and study to the effect of bleeding such timber for turpentine and thus far have failed to develop any substantial evidence showing that damage to the timber really occurs, either as regards tensile strength or its resistance to decay.

Field Reports on Tie Production

TAKING advantage of its district organization, this association makes a practice of calling upon its directors representing the various important tie-producing districts for statements of conditions in their respective areas. The reports presented by these district directors show the drastic curtailment in production that has resulted from the withdrawal of the railways from the market. They indicate also the even more violent curtailment of contract demands as a result of the large increase in right-of-way production.

Reporting for the Northeastern district, (that portion of the United States east of Indiana and north of North Carolina), A. B. Lacy (vice-president, M. T. Blassingham & Co., Inc., Norfolk, Va.) reported that production began to exceed the demand as long ago as July, 1930, being stimulated by the drought in the agricultural areas which caused many small farmers to turn to tie-production for a livelihood. This condition was accentuated by the decreased demand for lumber, which caused numerous small mills aslo to turn to tie production. In many areas in this district line production increased to such an extent as not only to force the curtailment or suspension of off-line contracts but in some instances to embarrass the roads in accepting the line production itself. Where reduced prices failed to retard the output, monthly allotments have been adopted to discourage production.

In the Southeastern district F. P. Dabolt (president, Tennessee Tie Company, Nashville, Tenn.) reported that sales are 25 per cent less than in the preceding year. Railroads purchasing right-of-way ties are accepting them in limited quantities. Northern roads that ordinarily purchase large quantities of ties in this territory are procuring largely increased percentages of their require-

ments from their own rights of way. Stocks in the southern part of the district are very small and over the balance of the territory are about 75 per cent of normal, with present production about 50 per cent of that of the previous year.

In the North Central states W. J. Foye (Foye Lumber & Tie Company, Omaha, Neb.) reported that the demand for crossties during the last year has been about 60 per cent of that for the preceding year, and the production has been reduced correspondingly, with the result that the stocks on hand now are somewhat less than a year ago. There is no serious surplus and there are no distress stocks in this area.

In the South Central district J. A. Tiller (J. A. Tiller & Son, Little Rock, Ark.) reported that conditions were fairly normal in the first quarter of last year but that as the season advanced and the drought became more pronounced, much labor turned from agriculture to tie production. With greatly reduced demand from the railways, this resulted in reduced prices. By the end of the year there was an almost complete shutdown in both production and purchase.

While the conditions under which ties are produced on the Pacific coast differ widely from those in the eastern and southern states in that practically all ties produced there are sawed, E. R. Wade (Charles R. McCormick Lumber Company, Portland, Ore.) reported that production was equally chaotic along the coast. The demand for ties was at an extremely low ebb during 1930. Most of the western railroads placed fewer orders than they had during any similar period since the war, and the anxiety to get the small amount of business offered resulted in a continual slashing of prices. The inability to secure tie orders in normal volume was such a serious blow to the small and medium-sized mills that the latter half of 1930 saw only 35 per cent to 40 per cent of such concerns operating.

Tie prices have declined steadily and have for some time been down to pre-war level. During the last few months the basis on which sales have been made has had no relation to the cost of production for the majority of plants. Such a limited volume of orders has been offered that the small concerns that have no accurate means of determining production costs have had an output sufficient to supply the demand, with the usual disastrous results.

Anti-Splitting Devices

By S. E. SHOUP

Assistant Engineer, Kansas City Southern, Kansas City, Mo.

MANY shapes of anti-splitting irons have been devised, but the number recommended by the Tie committee of the A. R. E. A. has been reduced to three shapes, namely, the S, the C, and the Saf-Tie, perhaps better known as the Beegle iron. The Tie committee recommends two sizes of each iron, the small size, about 5 in. overall, for No. 3-A and smaller ties, and the large size, about 6 in. overall, for Sizes 4 and 5. A width of ¾ in. and a 13-gage thickness with a double-bevelled edge are common to both sizes. In the opinion of the committee, 13-gage metal is the lightest that can be driven into hardwoods without excessive bending. This size is sufficiently strong to resist the internal fiber strains during the seasoning process of the timber without displacing any more wood than is necessary.

A recent test made at the Texarkana plant of the International Creosoting and Construction Company, provides some additional practical information on the holding power of anti-splitting irons. A pile of 12 to 14 ties had been selected from the seasoning yard, all of which were so badly split as to be unusable. By means of screw clamps the ends were brought together and irons applied. It was observed that two irons would hold splits 2 in. wide, but would not hold splits wider than that, the irons in most cases tearing the wood apart. In a few cases the irons were partially straightened and the wood ruptured to some extent. While these tests were not extensive enough and were not carried on with sufficient scientific rigidity to be conclusive, they are at least indicative of the following hypotheses: First, if two anti-checking irons will hold a split 2 in. wide in a thoroughly seasoned tie, they will resist the seasoning strain in a tie which would have split 2 in., since it is probable that at no time during the seasoning process is the strain as great as when completed. Second, if two irons will resist the strains causing a 2-in. split, one iron will resist the strains which would cause something more than a 1-in. split, because, in relation to the width of the split, the strains to be overcome are probably on an ascending curve rather than a straight line.

Economics of Anti-Splitting Devices

A tie that is split when put in the track is apt to split more under the impact of traffic. How much it will be affected is dependent upon the axle loads, the volume of traffic and the service conditions, such as ballast, roadbed, rail and tie plates. While a tie is under traffic there is no influence that conceivably would cause a split in it to close. Splitting begins almost entirely in the seasoning process, during which time a crosstie will lose 25 to 40 per cent in weight and 10 to 18 per cent in volume.

At present practically all railroads are giving every tie the best possible chance to render its fullest service. This is being done by treatment, pre-adzing and boring, careful and skillful handling and the use of good ballast and heavy rail. By this process, the life of ties has been increased from about 8 years to more than 25 years, or in excess of three times. I think it conservative to predict that ties being placed under present conditions will give an average life of 30 or 35 years. If a tie in the track costs $1.75, including the labor of placing, which is a fair average, and assuming a life of 30 years, the cost per year would be 5.83 cents. An iron can be applied in each end of a tie at a cost of about 2.5 cents, or two irons in each end for about 5 cents. If the application of one iron in each end increases the service of the tie only six months, and if two irons in each end increases its life a year, it is money well spent.

The next question is what is the probability that anti-splitting irons will achieve this result? The answer naturally divides itself into two parts, that concerning the producers and that concerning the railroads.

A Rule for the Producer

The producer's primary interest is in the acceptance of his ties by the inspector. Considering all grades, if one tie in 14, or 7 per cent, is saved by the application of an iron in each end of every tie, the producer is breaking even. However, the producer usually knows how long he will have to carry his ties before inspection and should know, with fair accuracy, the number of rejects on account of checking. This, of course, will be dependent upon the kind of wood, the season of the year, the weather and other variables. Last year the checking due to the intense drought was excessive. These factors should permit him to determine whether anti-splitting irons are justifiable from his standpoint.

The railroad is to use the tie for years, and its position, therefore, is entirely different. As a rule, the acceptance of the tie by the road is given early in the seasoning process, with the consequence that the major risk is taken by the railroad. Not only is objectionable checking apt to occur during seasoning, but even after treatment, either before or after the tie is placed under traffic. Internal stresses may cause additional checking, which is far more detrimental to the condition of the tie than before treatment, for portions not reached by the preservative may thus be exposed to air and water.

As an illustration of excessive checking I recently saw about 2,000 white oak ties of fine, healthy timber, which had been cut last fall and stocked in the seasoning yard in December. These ties were well up to specifications when inspected and had been seasoned during the most favorable time of the year. No anti-checking irons had been applied in any of them. At the time I saw them, fully 35 per cent would have been rejected because of checking. At least 5 per cent will be unusable and at least 85 per cent would have been materially benefitted by the proper application of end irons. This was the railroad's loss.

Largest Benefit to Railroads

It seems, therefore, that the producer and the consumer have a common interest in the application of anti-checking irons, with the railroad deriving the larger benefit. Would it not then be equitable for the railroad to require the producer to put irons in the ties immediately after manufacture, paying for the cost of the irons and their application at an agreed rate per accepted tie. In this way, the producer would benefit in the application of the iron until the tie is accepted, and his only cost would be the irons applied to rejected ties, which would normally be only a small portion and well worth its value as insurance. The railroad would derive the advantage of having the irons applied when their effectiveness is the greatest.

In my opinion some arrangement incorporating the major principles just outlined would be superior to the practice now followed by some roads of supplying irons to the producer for application. I believe that anti-splitting devices will receive more careful handling and application if the producer has an investment in them.

The proposition that every hardwood tie be equipped with irons as suggested above is sure to be met with at least three objections as follows (1) That many irons would be wasted by being applied to ties not needing that type of protection; (2) that it is impossible to determine the position in which an iron should be placed until the checking tendency of the tie has manifested itself; and (3) that driving an iron in a tie that would not have split naturally is apt to cause it to split.

In regard to the first objection, I consider that the number of ties which would not be benefited would be relatively small. As to the second objection, if men of experience use proper intelligence in the selection of the shape of iron and its location in the tie, ineffectiveness will largely be overcome. The third objection loses much force upon investigation. A split might, in rare cases, be caused by an iron, but if only the recommended shapes are used, the cases where they cause splits are so few that this objection becomes of the second order of importance.

In the southwest, from 60 to 75 per cent of all hardwood ties are pole or boxed-heart ties. These ties are more susceptible to checking than either the half-moon or quarter ties. Fortunately, it is easier to anticipate the direction of the probable split in a pole tie than in other kinds. It is apt to be vertical through the pith. An S-iron is almost sure to catch the major split, even though the straight part of the iron is not in the most advantageous position, which is perpendicular to the check. Frequently, the Saf-Tie shape can be used to great advantage.

The Application of Irons

A knowledge of timber and the general characteristics of checks should be the prime qualifications of men entrusted with the application of irons. The practice of giving an unskilled laborer a sack of irons and a hammer and letting him make the application without supervision cannot produce satisfactory results. The faults of this method are the poor selection of shapes and random placing. In the seasoning yard of the Kansas City Southern an inspector marks the end of each tie in which he wants an iron placed, indicating roughly with crayon the shape to be used and its location. He is followed by laborers who drive the irons.

I offer the following conclusions which, generally speaking, are in line with the recommendations of the Tie committee of the A. R. E. A.

1. Both the producer and user should be interested in the application of anti-checking devices.
2. Every tie made from hardwoods or broad-leafed woods should be protected by at least one iron in each end.
3. The three shapes of irons mentioned above have important and specific uses.
4. The waste of irons by improper placing can be minimized by intelligent application by experienced men.
5. Irons should be applied as soon as feasible after the manufacture of the tie and not later than when received at the storage yard for seasoning.
6. Economy results from the proper and generous use of irons.

Care in Handling Crossties

By HORACE PAUL
Chief Tie Inspector, Wabash, St. Louis, Mo.

THE necessity for greater care in the handling of ties from the time of their cutting until they are delivered to the roads is so self-evident to anyone who has ever inspected or handled ties as to make it rather difficult of exposition. The seasoning period prior to treatment is the critical period in the life of a tie. It is in these months that many sticks of originally sound timber are allowed to deteriorate through one cause or another. A sound tie safely seasoned is well on the road to service under rails.

Checking and decay are the two great menaces to a seasoning tie. If ties are piled close together, checking will be retarded but so will seasoning and one will probably have stack burn and serious decay. Hill timber and the judicious use of S-irons or some similar anti-checking device are the best safeguards against excessive splitting and checking. It does not take many split ties to pay for a lot of S-irons. The season of the year also affects the checking.

A Good Yard Is Essential

The much more serious problem is decay. Particular care should be exercised in the selection of yards where the ties are to be stacked. The drainage, the weed growth and the nature of the soil should all be considered. A yard should preferably be selected with a natural slope, allowing water to drain away readily from the ties. All weeds and growth should be kept down as they hold moisture and also retard the free circulation of air around

the bottom of the piles. Black loamy soil is much like a sponge in holding moisture. A yard surfaced with gravel or better yet, with cinders is to be desired. Rotten wood and other debris should be removed or collected and burned. In the past it was not uncommon to run across a stack of bright green ties piled on rotten stringers, but in many territories we now find the producers hauling sound blocks on top of their tie loads with which to make acceptable foundations.

The requirements as to stacking, with the ties well spaced, bottom ties at least six inches off the ground, outside ties in each layer edged, should be rigidly enforced as this admits of good air circulation and good drainage.

If these precautions to control moisture and decay are observed and if the ties were originally sound, they should still be sound when seasoned. Our practice on the Wabash is to get our ties into the treating plant as early as possible. We get over the line in normal times once each month and the ties at inspection are not supposed to be more than 30 days old. Then the ties are loaded into the plant within 30 days after inspection. This means that our ties are on the plant yard at from grass green age to slightly over three months old.

At the treating plant they are under the dual and daily inspection of our treating inspector and the plant forces. Every foot of yard space is cindered with the resultant excellent drainage. There is no foliage or rotting wood to foster decay. If the ties need S-irons they are ironed. When they are properly seasoned for thorough treatment, which is determined by the date painted on each stack, and from actual borings, the ties are treated and sent out to hold our rails.

Relative Merits of Different Woods for Crossties

By W. E. GOODWIN

Engineer of Tie Preservation, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

AT least 50 different varieties of woods are suitable for crossties. Their relative merits for this service depend on their strength, the locality in which they are to be used, the traffic they will carry, the mechanical protection provided, the character and amount of ballast and whether they are to be given preservative treatment or are to be used untreated.

To be suitable for crossties, a wood must have sufficient strength as a beam to support the rails, it must have compressive strength parallel to the grain to hold the spikes and must be hard enough to resist rail and plate wear. Although the serviceability of any wood for ties is dependent on its mechanical properties, some properties or combinations of properties are often brought into play, concerning which no adequate data are available. For this reason, the values presented in tables do not necessarily give a final measure of the exact suitability of various species of woods for crossties. They should rather be regarded as indicative of their utility. Service records, where available, are of great value in appraising the relative behavior of woods under a given set of conditions. Such records sometimes show that species with a fairly low composite tie-strength value surpass some of those with a higher rating.

To develop the full mechanical life of most crossties, it is necessary to give them preservative treatment. A comprehensive series of tests of preservatives which were started on the Chicago, Burlington & Quincy in 1909 show that, compared with the average life of 5.78 years for untreated ties, the same woods, when creosoted, have service lives ranging from 19 to 26 years. The same tests show that treatment with zinc chloride extends the life to from 14 to 19 years.

Similar records can be produced by other roads. On the Buffalo, Rochester & Pittsburgh, the average annual renewal per mile for the last 10 years has been 107. Similarly the renewals for 1930 were 120 on the Baltimore & Ohio; 151 on the Chicago, Burlington & Quincy; 99 on the Chicago & Eastern Illinois; 74 on the Delaware, Lackawanna & Western; 94 on the Michigan Central; and 124 on the Northern Pacific.

Careful consideration should be given to the relative merits of the different woods available, the intensity of the traffic they are to bear and methods of protection against wear and decay. If this is done, it seems reasonable to predict an average tie renewal of 100 ties to the mile. For the 27 roads reporting to the Tie Service Records committee of the American Wood Preservers' Association, this will mean a reduction of nearly 15,000,000 ties a year.

Monon Obtains Long Life From Treated Ties

By A. ANDERSON

Engineer Maintenance of Way, Chicago, Indianapolis & Louisville, Lafayette, Ind.

AS a result of close inspection and the practice of giving all ties preservative treatment, the annual tie renewals per mile of track on the Monon have been reduced from a maximum of 476 and a 5-yr. average of 430 to a 5-yr. average of 123 per mile of all tracks. Prior to 1908, all ties were used without treatment and almost any kind of a tie was accepted. Beginning with that year, purchases were limited to certain woods, inspection was improved and all woods except white oak were creosoted. Within five years the annual renewals began to decrease, the 5-yr. averages from 1900 being: 1900-1904, 293; 1905-1909, 420; 1910-1914, 430; 1915-1919, 194; 1920-1924, 151; 1924-1929, 123.

For the last 15 years all ties have been obtained along the line, being accepted only at stations; they are loaded into cars as they are accepted. They are purchased under C. I. & L. specifications. which are practically the same as those of the United States Railroad Administration, and include white oak, black locust, black walnut, red oak, honey locust, hickory, ash, beech, cherry and hard maple. About 25 per cent of all ties purchased are white oak, about 65 per cent are red oak and the remainder are divided among the other woods.

Beech and hard maple ties must be made from trees that have been felled between October and February and within one month after the trees are cut. Practically all ties accepted are Grade 3, which are 6 in. by 8 in. by 8 ft., and grade 4, which are 7 in. by 8 in. by 8 ft., although 5 per cent of Grade 2 ties, 6 in. by 7 in. by 8 ft., are taken. They are sent immediately to the storage yard for seasoning under sanitary conditions. Only about 500 ties have been lost through decay before treatment during the last 16 years.

In the beginning, we favored hewed ties, but lately we prefer sawed ties, about 65 per cent of our purchases now being the latter. We apply S-irons to all ties that show indications of splitting during the seasoning period, and are using anti-splitting devices on about 85 per cent of our ties. In addition, section foremen are provided with S-irons and are instructed to apply them when there is a tendency to split after the ties are in the track.

After the proper seasoning, all ties, now including the white oak, are given a 6-lb. treatment by the Lowry process, of a 60-40 creosote-coal tar mixture. Immediately after treatment they are shipped to the point of use and allowed to season for four months to a year before application.

A total of 2,750,000 ties are in service on the Monon, 98½ per cent of which are creosoted. Based on average annual renewals of 118,788 ties for the last five years, the average life of our ties is 23 years. We still have large numbers of ties in service bearing dating nails for 1908, 1909 and 1910. Many of the removals are due to rail cutting and spike cutting and not to decay, but with the more extended use of tie plates we are decreasing these causes of failure.

All ties removed from the track are segregated, those that have failed completely being piled separately from those that can be used for other purposes. We use old ties for fence posts, cribbing, foundation timbers and many other purposes. The Monon has not bought a fence post in 10 years.

Gum Ties on the Frisco

By LINN L. WHITE

Chief Clerk, Tie and Timber Department, St. Louis-San Francisco

OUR first treated ties were put in track in 1908, and at that time nine sections of test track were laid with white oak, red oak, pine and gum ties. With the exception of the white oak, the ties were treated by the Lowry process with 8 lb. of creosote per cu. ft. of timber. The test tracks were located on various parts of the line, under different traffic and climatic conditions—some of them were tie plated and some not. None of the ties was either adzed or bored.

A complete record of renewals in these test tracks was kept for 15 years, when, by applying the Forest Products Laboratory curve to the renewals during this time, we found the following expectancy of life:

Untreated white oak,.....	8.4 years
Creosoted pine	14.8 years
Creosoted red oak.....	20.3 years
Creosoted gum.....	23.4 years

We continued to use gum ties until the war, when we started to treat timber with zinc chloride on account of the shortage of creosote. While we were using zinc we discontinued buying both pine and gum ties and for several years we took only red and white oak, using the latter untreated. During this period gum ties fell into more or less disrepute with us and it was only after considerable deliberation that we decided about five years ago to buy them again. We started out in a modest way, but as we became more familiar with the wood's peculiarities, we lost our fear of it, and it now forms one of our most important tie timbers. All of our ties are made on our own lines. We can, therefore, be familiar at all times with the production, and watch it closer than if we had to send our inspectors to foreign roads.

Can Be Made Safely at all Times

We have all heard that gum should be cut in the winter months—that it is dangerous to attempt to handle it during warm weather. No doubt it is safer to restrict production to the cold months, but our experience is that gum can be handled successfully throughout the year. The one important thing is to get the ties to the treating plant as soon as possible after the tree is cut down. They should not be allowed to lie in the woods, but should be hauled to the loading point as soon as made. They should then be inspected as soon as possible and shipped at once to the treating plant. We do not allow gum ties to be loaded in closed cars but use coal or stock cars. After reaching the plant, they are yarded in the customary treating plant style, the same as our other ties. If handled in this way there is no reason why they cannot be seasoned properly without danger of decay.

It is possible to hold oak, and to a less extent, pine ties in the yard for some time after they are dry enough to treat, but gum ties should be treated when ready, as there is considerably more danger of losing them than either of the other woods. This is where we have to depend upon the judgment of the inspector at the plant and he must be an experienced man, for it is more difficult to detect incipient decay in gum than in either oak or pine. Personal knowledge of the age of the ties and the conditions under which they are seasoned are essential. We have had practically no trouble with our gum ties; in fact we have not lost or degraded 0.5 per cent of the ties received at the plants.

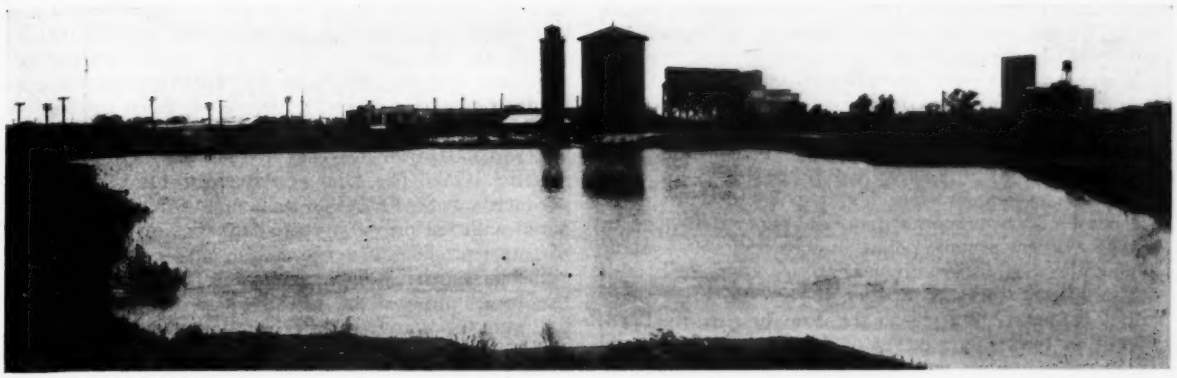
Favorable Service Reports

When we again started furnishing treated gum ties a few years ago, there seemed to be a general impression in the minds of our maintenance forces that they were decidedly inferior to oak—or about on a par with pine. A recent canvass of our division engineers shows a decided change of opinion. Without exception they are all satisfied with the ability of the gum tie to hold the gage and resist rail cutting. All preferred gum to pine and of the eight engineers, three preferred red oak as the best all-around ties, two preferred gum, and the other three stated that gum was as good as oak except on sharp curves. It is interesting to note that the most favorable reports were received from the southern parts of our line where gum showed up better than oak in checking and splitting. Furthermore, in case of derailment, there seems to be a growing feeling that gum ties will stand up better than any tie we have, for pine ties cut badly, and oak ties splinter. It should be understood that the oak ties referred to are not the so-called "southern oak," but are cut mostly from the hill timber in the Ozark region.

The first cost of gum ties is somewhat less than oak; there is also a substantial saving in the interest charge for carrying the ties during the seasoning period, as gum is ready for treatment in one-third to one-half the time required for oak. Theoretically, this would permit us to handle two or three times as many gum as oak ties in the same amount of space in the treating plant yard, although we do not obtain that efficiency in actual practice.

A few years ago we decided to treat all our switch ties, and we thought well enough of gum to buy more than 60 per cent of our requirements in that wood. While none of these switch ties have been in track long enough for us to obtain any service records, there seems to be no reason to believe that the gum switch tie will not perform equally as well as the crosstie.

TEN YEARS AGO.—A situation without parallel in the history of rail transportation has been precipitated by the decision of the Colorado Supreme Court, stipulating that the defunct Denver, Boulder & Western, which operated in the north-central part of Colorado, shall resume operations, notwithstanding the fact that the road was junked nearly two years ago—its rails torn up, its locomotives sent to China and South America, and its coaches and freight cars sold in this country.—*Railway Age,* May 6, 1921.



Water in Many Reservoirs Receded to New Low Levels

Meeting A Crisis in Water Supply

Drought of 1930 lowered railway reserves to the danger line and seriously impaired quality

THERE are ample reasons why railway operating and water-service officers in the United States should remember the drought of 1930 as the severest on record. The unprecedented deficiency in rainfall, which began late in 1929 and continued well into 1931, exhausted many water supplies, while others that had previously been dependable were practically at the point of exhaustion when the first heavy rains, which fell late in February, 1931, brought temporary relief. The adverse effect of the drought on the quality of the water that remained available was equally pronounced, forcing a widespread adoption of emergency measures, not only to overcome the shortage itself but also to provide water that could be used in locomotive boilers.

Forty states had less than normal precipitation in 1930, while in 20 of them the rainfall was the lowest on record, ranging in some instances, over wide areas, from 20 to 30 per cent below any previous record. During the summer months, precipitation fell to as low as 32 to 42 per cent of normal. The central area extending east from Oklahoma and Kansas and including Mississippi and the southern half of Illinois, Indiana, and Ohio, was most seriously affected. An abnormally hot summer gave added effect to the subnormal precipitation. Temperatures ranging from 110 deg. to 115 deg. were registered in nine states in this area, while 24 states reported temperatures of 100 deg. or higher on 20 to 100 days.

Water Supplies Fail

Detailed information as to the effect of the drought has been obtained from 16 railways which operate a total of 32,668 miles of lines in the central area where the combined effect of the lack of precipitation and abnormal temperatures was most pronounced. In this territory, these roads maintain 1,643 water stations, of which 1,048 are surface supplies and 595 are subsurface supplies from wells or springs.

Complete failure occurred at 66 water stations which depend on surface water and at 4 which obtain water from wells. There was also sufficient recession to cause concern or require action to conserve the supply at 758 stations served by streams, ponds or reservoirs and at 262 that are dependent on subsurface sources. These recessions varied from approaching exhaustion of reservoirs to partial failures of streams and springs which continued to flow, but did not furnish sufficient water for current needs. Underground supplies were less affected, but there was a general drop in the water table which increased the pumping head, with numerous partial failures of shallow wells.

Emergency Measures Were Necessary

Emergency measures to conserve the supply or improve its quality were necessary on every road except one in the area of severest drought. These measures ranged from the closing of certain stations for the remainder of the dry period to the development of new supplies. In many instances, where the stations could not be abandoned safely, orders were issued requiring trains to "run" them, except in emergencies, and then to take only enough water to make it possible to reach the next supply. In numerous cases where the supply was not actually exhausted but was diminished to the point where it was inadequate to meet full requirements, all trains were permitted to take water, but were restricted to the amount that was absolutely necessary.

At 16 stations, water was hauled for periods ranging from a few days to 140 days, or intermittently for several months. In 14 cases on 7 roads it was necessary to develop new supplies, in 6 of which it was possible to obtain the necessary water from cities, but at greater cost.

Other expedients included the placing of an extra engine tank or of a tank car on some trains to avoid taking water at restricted stations. On the Chesapeake & Ohio the use of tanks of 19,000 to 23,000 gal. capacity increased the safe distance over which locomotives could handle full-tonnage trains.

The cost of these measures necessary to protect fail-

ing or exhausted supplies ranged from a total of $4,000 to $6,000 on individual roads, although a limited few had no extraordinary expenses on this account.

Water supplies were generally affected as much, and in some cases more, in quality as in quantity, so that special attention to methods of treatment became necessary to counteract the unfavorable quality of those waters which, of necessity, had to be used. In some areas, surface waters were highly polluted with industrial wastes from tanneries, pulp and paper mills, and by sewage. Where organic pollution occurred, anti-foaming compounds were used with success. In other areas, mine wastes caused surface supplies to become highly corrosive. In nearly all parts of the drought area, the hardness of surface waters increased, until in some instances the incrusting solids were double the normal content of the water. The additional corrosive content of the water and the excess of incrusting solids were counteracted by a close check on the treatment and the use of boiler compounds. With these waters, foaming was frequent, but the trouble which was caused by the increased concentration of alkali salts was corrected, so far as possible, by additional blowing down of the locomotive boilers, more frequent washing and water changes.

Train operation was less seriously affected, however, than might have been expected. Some delays occurred as a result of foaming boilers. Minor delays also occurred on some roads as a result of more frequent stops for water or for stops at stations where water is not usually taken. Locomotive repairs were increased a small, but indeterminate, amount by the impaired quality of the water, but not enough to cause concern.

Purchases and Inventories Lower in 1930

COMPILATIONS just made by the Railway Age from special reports received from the railways on the value of materials purchased and used show that the direct expenditures made by the Class I railroads of the United States for materials and supplies amounted to $1,038,000,000 in 1930, compared with $1,392,535,000 in 1929, a reduction of $291,035,000, or 21½ per cent. These figures represent the direct purchases and exclude large purchases made indirectly through lump-sum contracts with builders of bridges, terminals and other work. While the aggregate purchases made directly by the railways in 1930 for materials and supplies were the lowest in many years, the expenditures were still large. It is also well to bear in mind that the relation between expenditures in 1929 and 1930 was influenced by lower prices in the latter year. According to additional reports received from the carriers, purchases made by the railways in January, February and March, 1931, were lower than purchases made in the corresponding months of 1930 but were inclined upward.

The direct purchase of forest products by the railways in 1930 amounted to $134,600,000 or $22,951,000 less than in 1929. Crossties accounted for $75,500,000 or $7,921,000 less than in 1929. For switch ties the expenditure was $9,150,000, or $1,492,000 under the outlay in the previous year. However, a much greater reduction occurred under the heading of lumber and timber, $43,550,000 being spent in 1930 or $11,482,000 less than in 1929. The amount expended for other forest products was $6,400,000, a reduction of $2,086,000, compared with the previous year. Statistics on the purchase of forest products in terms of the quantities of material either in board feet or, in the case of ties, in the number bought are not available at this time.

Purchases of iron and steel products by the roads, not including materials furnished by contractors in building construction or the steel and iron embodied in new cars and locomotives, etc., totaled $329,700,000 or $108,140,000 less than in 1929. Of this total, the largest outlay was for rail, amounting to $75,000,000 or a reduction of $14,195,000 from the corresponding outlay in 1929. However, in spite of the decrease, the expenditure for rail represented a greater proportion of the total for iron and steel products, namely, 22.8 per cent as compared with 21.5 per cent in 1929. Under the heading of frogs and switches, and other track materials, the purchases amounted to $53,700,000, or 16.3 per cent of the total, as compared with $70,971,000, or 16.2 per cent of the total, in 1929. Purchases of structural steel for bridges, turntables, and buildings, and bar iron and steel forgings and unfabricated shapes and pressed steel parts (used largely by the mechanical departments) involved an outlay of $39,200,000, or $18,130,000 less than in 1929.

The direct purchases of portland cement in 1930 amounted to $5,100,000, a reduction of $2,528,000, or 33.1 per cent, compared with 1929.

The capital which the Class I railroads of the United States had tied up in unapplied material and supplies at the close of 1930 amounted to $430,789,212, a reduction of $37,797,298 or 8.5 per cent from the corresponding figures for 1929, according to an analysis which has been made by the Railway Age of the reports filed by the carriers with the Interstate Commerce Commission. These inventories comprise the book value of the materials and supplies purchased directly by the railways and carried in stock for use. They do not include, however, any materials purchased and held for application by contractors doing work for the railways or special purchases of materials which have been bought and segregated for large construction projects which are being carried on independently of railway operations.

Statistics giving the money value of the stocks by classes of materials are not available for all railways, but the following partial figures embracing the returns from 100 railways, give a fair idea of the trend. The total inventory of these 100 properties on December 31, 1930, amounted to $29,725,720 for fuel, $81,870,476 for crossties and $38,063,930 for rail. The stocks of fuel represented an average of 40 days' supply, those for crossties an average of 10.9 months' supply, and those for rail an average of 4.9 months' supply.

Purchases of Fuel, Materials and Supplies by Class I Railways of the United States — 1923 to 1930

Item	1930	1929	1928	1927	1926	1925	1924	1923
Fuel	$306,500,000	$364,392,000	$384,608,000	$438,821,000	$473,354,000	$459,465,000	$471,656,000	$617,800,000
Forest Products	134,600,000	157,551,000	160,794,000	175,729,000	186,291,000	170,305,000	180,872,000	232,511,000
Iron and Steel Products	329,700,000	437,840,000	397,544,000	432,604,000	507,302,000	419,255,000	365,610,000	464,955,000
Miscellaneous	267,700,000	369,752,000	328,395,000	348,774,000	392,085,000	343,018,000	324,917,000	423,437,000
Grand Total	$1,038,500,000	$1,329,535,000	$1,271,341,000	$1,395,928,000	$1,559,032,000	$1,392,043,000	$1,343,055,000	$1,738,703,000

Tie Problem Discussed in New Bulletin

RULES to be observed in the selection, inspection, handling, treating, use and reuse of ties are outlined in Bulletin No. 10 which has recently been issued to the engineering and maintenance of way forces of the Buffalo, Rochester & Pittsburgh. This bulletin is one of a series dealing with various phases of maintenance of way and engineering work. Earlier bulletins have been presented in previous issues of *Railway Engineering and Maintenance*.

Bulletin No. 10 outlines the history of tie treating on the B. R. & P. and gives figures showing what has been accomplished in the way of reducing tie renewals since treated ties came into use. Five reasons for the excellent results attained are given and it is said that these results could not have been possible without the excellent co-operation of all officers, foremen and others in the engineering and maintenance of way departments. The bulletin contains a statement asking the intensive co-operation of each employee at this time and says that "we are now at a critical period in our treated tie history, having reached the point where many of the older treated ties are approaching the limit of their main track life, not particularly due to decay but on account of mechanical wear . . . and unless the keenest and most intelligent interest and heartiest co-operation is used by all concerned we cannot expect to realize to the fullest extent the enormous benefits that it is possible to derive from the use of treated ties."

2. Care in piling before loading and when received at the Timber Preserving Plant to allow seasoning and to prevent possible infection by fungus growth which would result in decay, and proper adzing of hewn ties at the Timber Preserving Plant before treatment to conform to the Ware Tie Plate Gauge, use of check irons to prevent splitting and painting ends of ties with hot creosote to prevent infection and reduce checking.

3. Thorough treatment by the Full-Cell Process, injecting 10 lbs. of creosote per cu. ft. of timber or about 4 gallons per tie.

4. Careful handling after treatment both when piling or loading at the Timber Preserving Plant and when unloading and piling out on the road to prevent damage by throwing them off cars on top of one another or on rocks, rails or anything else that would break pieces off of them or otherwise cause damage. Precautions to prevent bruising or other injury when putting treated ties in track by drawing them into the track with tie tongs instead of using picks, shovels or other tools for that purpose. The use of tie tongs or bars for moving ties into proper position instead of using spike mauls or sledges. Proper adzing of ties to conform to the Ware Tie Plate Gauge, brushing the adzed surfaces immediately with hot creosote, plugging spike holes with creosoted plugs after first pouring hot creosote in the holes when re-gauging or when treated ties are taken out of track.

These results could have been obtained only through the excellent co-operation of all officers, foremen and others in the Engineering Department.

The effective life of treated ties is measured by the number of years of use in main track plus the number of years of service in side tracks after their main track usefulness has been fully developed. **This means that treated ties must not be taken out of main track until they are no longer fit for such service,** taking into consideration all conditions that affect the service of the tie in the particular location where used, such as, kind and density of traffic, curvature, kind and condition of ballast, drainage, condition of neighboring ties, weight of rail and tie plates. The utmost care and best judgment must be used by tie inspectors for marking treated ties for renewal and it must be understood that a tie must not be removed for mechanical wear alone unless cut down 1" or more. **Treated ties which have been removed from main track must in every instance be considered as fit for further use in side tracks unless and until final inspection by Engineer Maintenance of Way proves them to be unfit for any further use.** These ties will doubtless have a life in side tracks far exceeding their life in main track.

To maintain our excellent record we must continue to handle treated ties with utmost care, and if we are to get full benefits from our expenditure for treatment, **we must make the maximum use of treated ties removed from main track for side track renewals.** With our main tracks almost fully tied with creosoted ties we can expect from now on for a short period to remove a larger number of creosoted ties from main tracks due to mechanical wear, adzing on account of rail laying especially on sharp curves, and checking or splitting. **Every one of these ties that can possibly be made use of must be used for side track renewals;** the best of them in important side tracks and the others in unimportant or standing tracks in yards.

All treated ties taken out of main tracks must be handled very carefully to prevent damage, bearing in mind that they are necessarily weaker and more liable to injury than new ties. They must not be left scattered for any considerable length of time, but must be piled promptly at or near the subgrade level in locations convenient for loading and where they will not be liable to harm from any cause. They must not be piled near untreated ties which are to be burned nor at points where people are likely to take them for firewood. Those ties which in the opinion of the Roadmaster, Supervisor of Bridges and Buildings or Inspector are fit for further use in sidings or bridges should be promptly loaded and shipped to locations where they are to be used, and those which are considered unfit for further use must be carefully loaded and shipped to the Timber Preserving Plant for further examination by the Superintendent of the Plant and Engineer Maintenance of Way. **Under no circumstances must treated ties taken out of track be thrown down the bank or left scattered along the right of way. No treated ties of any kind must be burned out on the line.** Ties to be shipped to other locations or to the Timber Preserving Plant must be loaded in low side cars, and the same applies when loading treated ties for shipment

BUFFALO, ROCHESTER AND PITTSBURGH RAILWAY COMPANY

BULLETIN NO. 10

CARE AND USE OF TREATED CROSS TIES, SWITCH TIES, BRIDGE TIES AND TIMBER

To Division Engineers, Superintendent of Timber Preserving Plant, Supervisors of Bridges and Buildings, Roadmasters, Tie Inspectors, Bridge Foremen, Extra Gang Foremen and Section Foremen:—

The wisdom of our policy and practice in the matter of treated ties, which has been followed consistently since we began treatment in 1910, has been amply demonstrated by the results so far obtained. The outstanding success of our policy in the use of creosoted ties is indicated by the fact that our average annual main track tie renewals per mile are now 103, while prior to the use of creosoted ties the average annual renewals per mile was about 250 ties. The full realization of the benefits resulting from the use of treated ties is only possible by a full understanding of the importance of all the details of good practice in the selection, treating, handling and care of treated ties and by intelligent co-operation of all concerned in the use of these ties and in following right methods and proper practice.

Our Timber Preserving Plant was constructed and put in service at Bradford in 1910; the first creosoted ties being placed in track during the latter part of that year. We have, therefore, been using treated cross ties, switch ties and bridge ties for twenty years. At first we treated all kinds of native timber among which were a large number of chestnut ties. During the war period, on account of shortage of creosote, a large number of pine ties were treated with zinc chloride; but this practice was discontinued on account of unsatisfactory results in this climate on account of moisture. Due to their not giving satisfactory service under heavy traffic, the treatment of chestnut ties and their use in main track has also been discontinued. Of the native ties, we have for years been treating only the hardwoods, mainly, beech, red oak and maple, and when the local supply is not sufficient, we have found it necessary to treat sap yellow pine ties from the south.

At the end of the year 1929, we had 1,621,231 creosoted and 201,504 zinc treated cross ties in main track, and 363,515 creosoted cross ties in side tracks. We also had 100,738 creosoted switch ties in track. Up to the end of 1929 there had been removed from main track the following creosoted ties which were taken out for the reasons shown:—

Decay	Dentitments	Broken, Split and Checked	Mechanical Wear	Replacements	Total Removed
3,256	28,652	30,186	32,240	3,212	97,546

Note the remarkably small number of ties removed on account of decay; less than four (4) per cent of the total removed. Seventy (70) per cent of the treated ties removed from track for all causes except decay have so far been re-used in side tracks by turning them over and tie plating them.

Our main tracks, including main tracks of important branches, are now more than 90% tied with creosoted ties. Our records so far indicate an average life in main track for our creosoted ties of 30 years. The very excellent results we have obtained from the use of creosoted ties are due to several reasons:—

1. Careful selection and inspection of the ties when purchased.

from the Tie Plant. They should be loaded in low side cars as far as such equipment is available. When creosoted ties are re-used in side tracks, they must be protected with large tie plates and extreme care must be used in placing them in side tracks in order not to damage them.

Every one in anyway concerned in the selection, inspection, handling, treating, use and re-use of treated ties, must understand that we are now at a critical period in our treated tie history, having reached the point where many of the older treated ties are approaching the limit of their main track life, not particularly due to decay, but on account of mechanical wear, splitting, checking or other similar cause, and unless the keenest and most intelligent interest and heartiest co-operation is used by all concerned, we cannot expect to realize to the fullest extent the enormous benefits of the use of treated ties. At this time, more than ever before, it is necessary to give the most careful consideration to the matter of removing treated ties from main track, and in case of any doubt or uncertainty as to whether a tie has reached its limit of economical life in track, it should be given the benefit of the doubt and should not be removed. Even though a very large proportion of treated ties taken out of main track are used again in side tracks, this does not warrant the promiscuous removal of such ties from main track until or unless they are no longer fit for the service imposed. **On the other hand, treated ties should not be left in main track so long that they become so badly cut by mechanical wear that they would be worthless for use again in side tracks.** Inspectors marking ties for renewal must use their very best judgment as to when each individual tie has served its full life in main track, bearing in mind the desirability of further use in side tracks.

This is a matter of such urgent importance at this time that each Roadmaster should immediately go over his territory on motor car and personally hand each foreman a copy of these instructions and explain them fully. Supervising officers, foremen and tie inspectors should be required to again carefully review Chief Engineer's Circular Letter No. CE 900, Subject: Revised Instructions Covering the Disposition and Recording of Treated Ties Removed, dated November 1st, 1928. The Division Engineers should personally furnish the Tie Inspectors with a copy of this letter and instruct them verbally. This important matter should be continually followed up by all of our supervising force to see that we get the best results and full return upon our investment in the use of treated ties.

E. W. HAMMOND,
Engineer Maintenance of Way.

E. F. ROBINSON,
Chief Engineer.

Rochester, N. Y.,
July 26th, 1930.

This Bulletin Was Distributed Among the Engineering and Maintenance of Way Forces

WHAT'S THE ANSWER?

Have you a question you would like to have someone answer?
Have you an answer to any of the questions listed here?

To Be Answered in the August Issue

1. *On multiple track lines, what advantages, if any, are there in diverting the traffic during the working period of the day to facilitate the laying of rail or the installation of ballast?*
2. *What use, if any, can be made of obsolete bridge timbers of odd sizes which are not suitable for use in standard timber trestles?*
3. *What effect does wide or irregular gage have on track maintenance and the riding qualities of the track?*
4. *How can a wood plank floor on an outside platform be laid to facilitate trucking?*
5. *What incidental work should be given attention while ties are being renewed?*
6. *How large a stock of pipe fittings should a water-service repair gang be permitted to keep on hand for normal maintenance use?*
7. *What precautions should be taken to prevent track from buckling when surfacing during hot weather?*
8. *What methods can be employed to install falsework for the construction of a new opening in an embankment where the character of the material in the fill or underlying strata does not permit the driving of piles?*

Skeletonizing Track

When spot surfacing, should the track be skeletonized before starting to make the raise? Why ?

Not if the Ballast Is Clean

By Assistant District Engineer

This is typical of many questions arising in track work where the method must be selected to meet the conditions surrounding the particular job that is in hand. The method to be selected in this case depends primarily on the condition of the ballast.

If the ballast is of low quality or has become fouled, and particularly if the ties are pumping, the track should be skeletonized with a view to cleaning out the mud or other foreign material. If the ballast from the cribs can be cleaned, this should be done, returning the salvaged material to the cribs. If cleaning is not practicable, the foul or worn material should be replaced with clean ballast from the shoulder and new ballast added later to fill out the section and for dressing.

On the other hand, if the ballast is clean and of satisfactory quality, the track should never be skeletonized for spot surfacing. This practice serves no useful purpose and will result in a waste of good material, in addition to which there is a measurable labor cost for handling the material out of the track and back again. Only enough ballast should be removed to open the crib properly for tamping.

Sees No Purpose in Doing So

By V. H. SHORE

Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

Skeletonizing track for spot surfacing serves no useful purpose and is objectionable for several reasons. It is much easier, on light raises, to hump track that has been cribbed and, conversely, it is more difficult to avoid doing so. The best practice is to have the tampers remove just enough ballast from each tie to give room for tamping. Time and labor will be saved if it is used to fill around the tie that was last tamped.

Where the ballast is foul, it should be cleaned wherever surfacing is done, if for only a rail length. In this case the track should be skeletonized, the ballast cleaned and the track partly filled with the cleaned material before the surfacing is started. Care should be exercised to bank the ends of the ties to avoid the possibility of sun kinks during hot weather. The practice should be the same whether the tamping is done by hand or with tie tampers.

Skeletonizing Is Wasted Effort

By Engineer Maintenance of Way

There is no purpose in skeletonizing the track when spot surfacing or even in making a general raise, unless the ballast is in such a condition that it requires cleaning or complete renewal. In making a general raise, the track should be skeletonized only if the ballast is foul or worn out, or if a new type of ballast is to be substituted for that now in use.

Much less is it necessary, if the ballast is clean, to skeletonize for spot surfacing, where the work frequently consists only of picking up low joints or low intermediate spots, or leveling over the space of a few intermediate ties. In work of this character, it is desirable to remove only enough ballast from the crib to give access to the tie for tamping. The labor connected with this operation can be reduced if the ballast removed in opening up the crib is transferred to the cribs on either side of the last tie tamped.

Opening the cribs to give access for tamping should not be started until the track has been raised on the jacks and the adjacent ties "caught," since the lifting of the track tends to loosen the ballast in the crib, thus facilitat-

ing its removal. Furthermore, considerable time and effort will be wasted in determining the limits between which the cribs should be opened, if this work is done in advance of the raising.

On the other hand, if any of the ties are pumping, the foul ballast in the adjacent cribs should be removed and cleaned or discarded, and clean ballast should be taken from the shoulder to make up the deficiency. Under any other circumstances, the skeletonizing of track for spot surfacing is wasted effort.

Washing of Paint

What causes the paint film to "wash" on wood and steel surfaces? What, if anything, can be done to prevent it ?

Surfaces Should Be Clean

By A. F. RANDOLPH
Engineer Paint Train, Pennsylvania, Harrisburg, Pa.

When repainting wood surfaces from which the old paint has been removed by means of lye, a varnish remover or other type of paint remover, they should be washed thoroughly with turpentine or benzine. Otherwise, the alkali which forms the base of the paint remover will attack the new priming coat and cause it to wash.

If a highly varnished surface is not roughened before it is repainted or if the paint to be applied to such a surface contains an insufficient amount of pigment, the new application is likely to wash. Furthermore, if a surface has been painted previously with a mixture of pigment and old oil, that is oil that has been allowed to stand until it becomes "fatty," the old paint should be burned off or roughened with a steel brush before it is repainted. Otherwise the new coat will wash.

If a shop coat of paint containing boiled linseed oil has been used on a steel surface, it should be removed, with a sand blast if necessary, to secure a clean surface. Otherwise the pigment in the priming coat will separate from the oil, since the shop coat is greasy or fatty, and wash, as on wood surfaces where a fatty oil has been used previously. An insufficient amount of pigment in any paint applied to steel surfaces will cause washing.

Is Caused by Soluble Pigments

By Master Painter

Washing is indicated by streaks near the lower part of the painted surface, such as on the lower flanges of girders, at column footings, along the lower edge of weatherboarding, etc. This condition occurs almost exclusively with paints in which pigments are used that are soluble in water. As they are exposed they are dissolved by the rain or other moisture which comes in contact with the surface. The water runs down and evaporates, leaving the dissolved pigment as a streaked deposit on the lower part of the surface.

Washing occurs most frequently and in most acute form in localities where the atmosphere contains an appreciable amount of sulphurous fumes. For this reason, painted surfaces around engine terminals and shops, in busy switching yards and on viaducts over operated tracks, are likely to give more trouble from this cause than elsewhere.

There is little that can be done to cure the trouble, since it is inherent in the paint. It can be minimized, however, by repainting with a paint containing insoluble pigments. The best results are obtained by applying as the final coat a paint that is elastic and that will retain its gloss for a maximum period.

Good Material and Clean Surfaces

By E. C. NEVILLE
Master of Bridges and Buildings, Canadian National, Toronto, Ont.

Paint will wash if the surface to be covered is not properly prepared to receive it. As an example, a greasy film is formed on the exterior surfaces of structures that are exposed to smoke and soot. Unless this deposit is removed and the surface made thoroughly clean, it is quite likely that the paint film will begin to wash soon after application.

Another cause is excessive humidity. Since it tends to retard the drying of the film it promotes wash, especially if the paint has been applied to very hard or glossy surfaces. Inferior vehicle and insufficient or improper mixing of the colors sometimes causes wash.

To eliminate or minimize this condition, care should be exercised to remove any grease or other dirt and moisture from the surface that is to be painted. Only satisfactory materials that are properly mixed should be used. There will be less danger of wash if, before applying oil paint to a hard glossy surface, it is well rubbed with a chamois, even though the surface is thoroughly dry in the beginning.

Repairing Old Arches

Where an old stone or concrete arch of moderate span shows indication of failure, what methods of repair, if any, can be employed to avoid renewal of the structure ?

Method Depends on Cause of Failure

By Engineer of Bridges

Arches fail from three principal causes: Failure of the foundation; disintegration of the masonry; and increased loading. The method of repair best adapted for a particular structure will depend, therefore, upon the type of failure and the conditions surrounding the structure.

Foundation failures may be of such a character that repairs are impossible, in which event the only recourse is to replace the structure. Often, however, the defect can be corrected by underpinning the footing or dropping a curtain wall in front of it. In one case of a 7-ft. arch with 10-ft. bench walls, we were able, by constructing it in short sections, to install a reinforced concrete mattress, extending across both footings. While considerable difficulty may be encountered in carrying out any of these expedients, they will generally be much more economical than the replacement of the structure.

Disintegration may result from defective drainage or excessive loading. If water is present and the disintegration has not progressed too far, conditions may be greatly improved by opening weep holes at the proper points in the arch ring and bench walls. Occasionally, special methods of draining the embankment will give good results.

If disintegration has begun, it is likely to become progressive. For this reason, it is good practice to line the

arch ring and, generally, the bench walls, with a jacket of gunnite or deposited concrete, which may be plain or reinforced as conditions demand.

Many old stone arches that are well preserved fail from excessive loading as the weight of locomotives increases. I recall a case where about 25 such arches, varying from 6 ft. to 20 ft. in span, began to fail within a few months after the introduction of heavy Pacific type engines on the district.

On this district the structures were preserved by lining them with reinforced deposited concrete, the jackets ranging from 6 in. to 12 in. in thickness. As we were unable to develop a method for calculating the amount of reinforcing that was required, or the exact manner in which it would act, we settled this difficulty by putting in what we thought would be enough. Apparently we were on the safe side, for the arches, one of which is a 20-ft. span with more than 50 ft. of fill above the crown, still stand with no further signs of failure. For individual structures, the cost of the work ranged from $1,200 to $4,700, as compared with estimated costs ranging from $10,000 to $50,000 for replacement.

Cement Gun Is Sometimes Effective

By A. E. BECHTELHEIMER
Assistant Engineer of Bridges, Chicago & North Western, Chicago

Often a condition of the character assumed in the question can be corrected effectively by the use of a cement gun. A careful survey of the conditions surrounding the structure should be made, however, and the plan for doing the work should be sufficiently comprehensive to insure an actual reinforcement of the structure.

If the bench walls are in good condition, the reinforcing coat of concrete, which should be about 2 in. thick, should start at the springing line. The concrete lining should be strengthened by means of steel reinforcing rods that are securely tied to the old structure. The new material should be properly notched into the old masonry at the springing line. The entire work should be handled under strict and experienced supervision.

Where the bench walls or footings or both are in need of repairs, they should first be strengthened by using deposited concrete to provide the necessary jacket. After this concrete has hardened, the work above the springing line can be cared for in the manner already outlined.

The Opening Must be Reduced

By G. M. JOHNSON
Supervisor of Bridges and Buildings, Wabash, Peru, Ind.

Repairs to falling arches, if they go beyond mere patching, can be made only by reducing the width and height of the opening. For this reason, the method to be followed will often depend upon the size of the existing opening and the amount of reduction that is allowable.

In many cases, changed drainage conditions make it unnecessary to maintain an opening of the area originally provided. In such cases pipe of the proper size can often be inserted in the arch and the space between the pipe and arch filled with earth or other suitable material. While this method does not fall strictly within the requirements of the question, it may sometimes be an economical way out of a serious difficulty.

Probably the most satisfactory, as well as the most commonly used method of repair is to line the arch with reinforced concrete. The simplest method of application is to insert dowels into the masonry, set the reinforcing steel and tie it securely to the old masonry and then apply the concrete with a cement gun. This method is not adapted for lining arches less than 6 ft. in span, however, because of the requirements for working space.

Finally, it may sometimes be economical to reinforce the bench walls with deposited concrete and complete the arch ring with a lining of hard-burned brick.

Johnson Grass

What methods, if any, can be employed to eradicate Johnson grass ?

Persistent Cutting Brings Results

By F. T. BECKETT
Engineer Maintenance of Way, Chicago, Rock Island & Pacific, El Reno, Okla.

Johnson grass is the bane of trackmen during the summer months in the territory south of a general line extending through Tucumcari, N. M., and the line separating Missouri and Arkansas. This plant spreads by two methods, seeding and the creeping or extension of its underground roots, from which it sends up new stocks.

It can be controlled by careful and persistent cutting or burning, so that no seed is allowed to mature. Several of the weed destroyers on the market are quite effective, if applied to the stocks during the growing season before the seeds form.

Weed Destroyers Give Best Results

By District Engineer

In many sections of the Southwest, as well as over widely distributed areas elsewhere, Johnson grass is one of the worst pests known to trackmen. Because of the manner in which it spreads, partly by the extension of its creeping underground root system and partly by seeding, eradication is difficult and in some cases almost impossible. On open land it can be controlled and often eliminated by close pasturing. This means of control is impracticable, however, on the track and right of way.

Persistent and frequent cutting to prevent seeding and to exhaust the plant food stored in its root system will also eradicate it, but this, too, is impracticable on the roadbed, and usually is on the right of way. Furthermore, if any plants remain on the adjacent land, another invasion is practically certain in a comparatively short time.

Numerous efforts to eradicate Johnson grass by means of chemicals have been made, generally without success. A heavy dosage of kerosene kills the foliage and retards later growth during the season, but is wholly ineffective so far as eradication is concerned. Better results are obtained with arsenic compounds, the foliage being killed in a comparatively short time. Neither of these chemicals affects the roots, however, so that eventually the growth returns with the same vigor as before.

Better results are obtained with weed destroyers which have one of the chlorates as their base. In making the application, whether by spraying or by drenching, because of the heavy compact growth of a well-established stand of this grass, a single dosage is seldom completely effective, so that second and even third applications are sometimes necessary. These chemicals kill the top growth somewhat more slowly than the arsenic compounds, so

that an early comparison of the effect of the two sometimes leads to the conclusion that the latter is more effective. This is not the case, however, since the longer time effect is in favor of the chlorates.

By its very persistence, Johnson grass requires untiring effort, if it is to be eradicated. For this reason, it is a mistake to use half-way measures. Control is not sufficient; complete eradication offers the only relief from this pest. It must be borne in mind too, that eradication is no bar to later invasions, since there are many means whereby it is given opportunity to gain a foothold in the same ground as before.

Discing and Planting Clover Helps

By C. E. SANDOVAL
Section Foreman, Southern Pacific, Tubac, Ariz.

Getting rid of Johnson grass presents an extremely difficult problem. Johnson grass is well rooted on about four miles of my section and every year it is growing heavier and the plants stronger. As an experiment, I have dug the plants out, root and all, at several selected places, in an effort to eradicate it, but the following spring it only grows thicker and more rank.

There is a method, however, which can be employed, which might be effective in eradicating or at least minimizing the growth on the right of way. I have observed on ranches where Johnson grass has spread, that if it is well disced about twice a year and clover or alfalfa is planted, the crop diminishes quickly, since these grasses seem to retard the growth of the creeping roots through which Johnson grass spreads principally.

After the ground is disced and the roots are cut, it is plowed in preparation for the seeding with clover or alfalfa. This in itself kills some of the roots and tends to retard the growth of the remainder until these grasses are strong enough to choke the growth of the delicate roots of the Johnson grass.

Air-Lift Pumping

What are the relative advantages and disadvantages of deep-well pumps and air lifts for wells having a depth of 80 to 100 ft. ?

Air Lift Efficient Only in Deep Wells

By GEORGE L. DAVENPORT, JR.
Assistant Engineer, Atchison, Topeka & Santa Fe, Los Angeles, Cal.

Unless the water contains considerable sand, or the well is too crooked to permit the insertion of a deep well pump, I would not consider the use of an air lift for wells less than 100 ft. deep and would prefer to make 150 ft. the minimum.

On the Coast lines of the Santa Fe it is our practice to use deep-well turbines for lifts up to 230 ft., of which not more than 150 ft. is below the surface. Some of these pumps are direct-connected to electric motors, while others are belt-connected to semi-Diesel engines. Pumps of this type are more efficient than air lifts for depths up to 150 ft. with total heads up to 230 ft., and they are equally reliable. If power current is available, turbine deep-well pumps can be controlled readily by float switches, thus eliminating the necessity for constant attendance. We rarely consider reciprocating pumps for this service, since their reliability is low and the cost of maintaining them is high as compared with turbine pumps.

Wells can usually be kept free of sand by using some method of gravel-wall construction, if the water bearing formation demands it. With this precaution, turbine pumps can be used in practically every instance. Occasionally a case arises where the air lift is better adapted for such wells, even though they are less than 150 ft. deep, owing to the fact that compressed air can be transmitted over long distances. An example is a coal chute, a shop or other facility, at which a compressor is installed. Although the wells may be some distance away, an air lift will enable a single attendant to look after both.

Wells up to 100 ft. in depth can usually be drilled straight; they should preferably be 16 in. in diameter, however, to make certain of the setting of a turbine pump. While an air lift will operate successfully in a crooked hole, it should be employed only as a last resort for such low lifts as 80 to 100 ft.

Needless to say the air lift rapidly becomes more valuable as the depth increases, and for heads above 300 ft. it is practically necessary for the operation of any drilled well. In this discussion depths are intended to refer to pumping water level and not to the bottom of the well.

Air Lift Indicated in Special Cases Only

By C. R. KNOWLES
Superintendent Water Service, Illinois Central, Chicago

So many factors enter into consideration in the selection of deep-well pumping equipment that an answer in general terms to this question may be misleading when applied to specific cases. Regardless of the depth of the well (the pumping level), there are certain factors that must be taken into account in selecting the pumping equipment, and these are fundamental if the decision is to be made wisely. They include the demand on the station, the pumping head, the character of the water, the probable maximum rate of pumping, the diameter and alinement of the well, its capacity, the kind of power available, the cost of the equipment and the probable cost of operation and maintenance.

In general, I would not consider the air lift as desirable for wells ranging from 80 to 100 ft. in depth, the principal objection being the difficulty in maintaining the submergence necessary for efficient operation.

Reciprocating or turbine pumps are better adapted for pumping at this depth. They cannot be installed, however, in wells of too small a diameter or of very crooked alinement. Neither should they be used where the water contains appreciable quantities of sand or other gritty material.

Air lift pumps have no moving parts, so that they are not noticeably affected by sand or grit. On the other hand, the plungers, cylinders and valves in reciprocating pumps and the impellers and bearings of turbine pumps are quickly destroyed by any considerable amount of sand or grit that may be carried by the water. An air lift can be readily installed in a well that is crooked or out of plumb, since there are no rods, shafts or other moving parts to be affected by the alinement.

If a number of scattered wells are to be pumped, or they are a considerable distance from the point of attendance, the air lift is often more convenient, since the air can be piped from a central compressor station. In some cases, the air lift is desirable as an aid in the removal of iron or other impurities from the water.

The first cost of the air lift, exclusive of the com-

pressor and power unit, is much less than that of any other form of deep-well pump. For this reason, where ample compressor capacity is available without additional expense, say at shops and engine terminals, it is sometimes advisable to use air lifts rather than incur the expense of installing other types of deep-well pumping equipment.

Heating Engine Pits

From the standpoint of maintenance, what are the relative advantages and disadvantages of the direct and indirect systems of heating engine pits ?

Direct Radiation Too Easily Damaged

By FRANK R. JUDD
Engineer of Buildings, Illinois Central, Chicago

It is assumed that the question excludes unit heaters and that "indirect" refers only to the hot blast system from a centrally located heater.

Direct radiation, whether by means of pipe coils or cast iron radiators, is subject to damage from falling materials in engine pits and from contact with trucks, cranes, etc., when placed on back walls or partition walls. It is also subject to rapid deterioration from the gases and moisture in the house, so that repairs are usually heavy and renewals frequent. Hot-blast units, being located in a separate room, are not seriously affected by the smoke and gases.

With the direct system there is little if any movement of the air in the house, as contrasted with the positive circulation of the indirect system. As a result, the fumes remain in the house for only a short time where the latter system is operated, besides which the smoke that does remain is being constantly diluted with outside air.

Delivery of the hot blast is made at selected points, largely in the pits, through a series of underground ducts, so that there is nothing in the pits to get out of order or maintain. The heating units and fans, being isolated, are seldom damaged, so that maintenance is extremely small as compared with that of direct heating. In fact, this equipment has been known to run for a number of years without requiring any maintenance, other than occasional adjustments to engine or fan.

Maintenance of Direct Systems is High

By A. T. HAWK
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

A specific disadvantage of direct radiation for heating engine pits is the frequent and expensive maintenance that is required. As the pipe coils or radiators must be located, they catch accumulations of dirt and debris, such as cinders, dirt from boiler washings, sweeping, etc.

There is also a tendency on the part of workmen in the pit to lay planks across the top of this radiation, to facilitate their work. It is not uncommon for them to do a certain amount of jacking on these planks, thus bending the pipe coils or radiators out of line, if it does not disrupt them. The permanent sag resulting from this practice traps the condensation, after which the radiation ceases to function.

Furthermore, the pit radiation being alternately wet and dry, corrosion is rapid and renewals are frequent. Since modern engine pits are long, it is difficult to remove the condensation unless the radiation is broken up into comparatively short individual units. The only advantage of this method of heating engine pits is the comparatively low cost of original installation.

With the indirect system, all of the heating and distributing equipment is in a separate room away from the gases, dirt and moisture of the enginehouse, and the heated air is led to the point of delivery through underground ducts. There is nothing in the pit to be damaged or get out of order. Dampers are provided so that, if the workmen in the pit get too warm, all they need to do is to shut off one or more ducts. The only disadvantage of this system is the high cost of original installation.

Recently we have been installing unit heaters with considerable success at a cost comparable to direct radiation. Two methods of installation are used. In one the heater is supported on the rear wall between two pits with outlets in each pit. In the other, the inlet is close to the floor and the heated air is discharged from the top of the unit. Care must be exercised, however, to avoid siphoning the heated air out through the smoke jacks. Dampers in the jacks eliminate this trouble. The maintenance of unit heaters is far less than that of direct radiation.

Another type that is coming into use consists of heater units suspended from the roof members. This type is light in weight, inexpensive and easily maintained. The same care must be used, however, to direct the air from the outlet so that it will not be short circuited into the smoke jack. From the standpoints of original cost, operation, maintenance and the results attained, I am of the opinion that this type best meets the requirements of enginehouse heating.

Laying Rail

When laying rail on multiple track lines, should the work be done with or against traffic? Why ?

It Is Better to Work Against Traffic

By Chief Engineer

Both experience and observation indicate that there are a number of advantages and no disadvantages in laying rail against traffic. Wherever practicable we divert traffic for laying rail on multiple track lines, in which case some of the advantages are not quite so marked, but they are still of sufficient importance to be in favor of working against the current of traffic.

In the first place, we believe that safety is promoted by requiring trackmen to face oncoming trains. For this reason, we insist that when working on multiple track lines, whether they are spot surfacing, renewing ties, tightening bolts or doing any other of the numerous tasks that are required in maintenance, they shall work against traffic. The same instructions govern when applying ballast or making a general raise in surfacing, although there are other important reasons in this case.

It is extremely difficult to maintain uniform or proper expansion when laying rail with the traffic. While we require the immediate application of anti-creepers, this work cannot be completed ahead of the spiking gang, so that there is always a considerable stretch of the new rail that is not protected against creepage. Brake applications made by approaching trains almost invariably cause a measurable amount of creepage of the unprotected rails. If the laying is done against traffic the old well-bedded rail will absorb the stresses that cause the creepage, or if the rail does move no harm is done, since it is to be replaced shortly.

It is not our custom to make closures with a switch point. This practice is often cited as an argument for laying rail against traffic. There is no reason, however, why closure with a switch point cannot be made as safe in one direction as in the other, provided proper care is exercised. It is our practice to provide rail gangs with short sections of the new and old rails, splicing them with a compromise joint, for the purpose of making closures, cutting one of the old rails as may be necessary. This method avoids any possibility of causing damage to the ends of the new rails or to car wheels during the passage of trains over the point of closure.

Can Be Laid in Either Direction

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

In my opinion it matters little whether the rail is laid with or against the traffic. The plea that the end of the new rail is damaged more by approaching trains can be very easily taken care of by keeping a special rail on hand for making all closures. The movement of the rail caused by braking can be minimized to the point where it is negligible by applying anti-creepers close on the heels of the spiking gang.

My own observation is that the results obtained in laying rail depend more on the ability and efficiency of the foreman in charge of the work than on the direction in which it is laid. A poor foreman will invariably produce a poor but expensive job, while a capable foreman will do his work well and with economy.

Maintaining Expansion is Important

By G. STAFFORD

Section Foreman, Canadian National, Rosebud, Alta.

One of the most important of the many interconnected operations involved in laying rail is that of insuring that the proper expansion allowance will be maintained from the outset of the work. For this reason, I am decidedly of the opinion that best results are obtained from laying rail against traffic. For a considerable distance approaching the working point, the track is subject to increased stresses resulting from brake applications, causing a tendency for the rails to move ahead. It is better that this movement should expend itself in the old rail than in the new.

I am aware that many maintenance men are averse to laying rail against traffic, especially where closure is made with switch points, which in this case must be placed in the facing direction. But even when the work involves a different rail section, the point of closure can be made so secure by clamps and braces that the danger element is entirely removed.

Prefers Laying Against Traffic

By R. ROSSI

Yard Foreman, Chicago & Alton, Chicago

There are marked disadvantages in laying rail with the traffic. In the first place, the approach of trains cannot be observed as easily, this being particularly objectionable on foggy days or in other weather when the visibility is low. Furthermore, the rail cannot be held to uniform expansion as easily, since brake applications to reduce speed or stop tend to shove the rails ahead, thus extending the rail gap and opening the way for later excessive rail batter.

It is safer for the trackmen to face approaching trains while at work, even with dependable flagging. If the flagman fails, there is more opportunity to prepare for the passage of the train, so that serious results from this failure may be avoided. The stopping of the train does not cause movement in the newly laid rails, so that the expansion remains unaffected. However, as an additional precaution, the application of anti-creepers should follow the rail laying as closely as practicable, regardless of the direction of laying.

Should Lay It with the Traffic

By Assistant District Engineer

It is preferable to lay rail with the traffic on multiple track lines. The primary reason for this is that there is less likelihood that the new rail will be damaged at the point of closure. The wheels rolling from the new rail do not cause as much damage as occurs when the direction of the movement is reversed, since the shock of the drop from the new to the old rail is taken by the latter. Furthermore, broken wheels occur less frequently at the point of change in sections when the rail is laid with the traffic. So far as the work itself is concerned, the track is as safe for traffic in one direction as in the other.

Lock Tamping

What are the relative advantages and disadvantages, from the standpoint of maintaining surface, of lock tamping and tamping the tie from both sides ?

Prefers to Tamp Both Sides of the Tie

By W. H. CLEVELAND

General Track Inspector, Atchison, Topeka & Santa Fe, Wellington, Kan.

Long experience in resurfacing track indicates that there is no advantage in lock tamping where a permanent smooth-riding surface is desired. Superficially it may appear that, since only alternate cribs are opened, lock tamping will reduce the total effort required. Actually, however, the saving in effort is more than absorbed in the extra work that is performed in tamping from one side, provided the ties are tamped to a uniform bearing.

To tamp a tie properly that is 8 or 9 in. wide, the ballast must be forced clear across this face to the opposite side, and this requires time and care, as well as considerable effort. Furthermore, one can seldom be certain that the tamping is uniform all of the way across. In fact, it rarely occurs that it is. On the other hand, if the tie is tamped from both sides, it is necessary to force the ballast only half way across the face of the tie, and this can be done in less time with less effort and with the assurance that the ballast is compacted uniformly throughout the area.

When tamping from one side only, it is difficult to make an equal distribution of the ballast or compact it uniformly across the entire width of the face of the tie. The result is that the tie is not supported uniformly until the bed is equalized by the compressive effect of the traffic. This method of equalization, however, depresses the track, distorts the surface and causes rapid deterioration of imperfect ties.

It is barely possible to support our present-day wheel loads satisfactorily upon a uniformly compacted bed of ballast. Tamping that is done from both sides of the tie

gives a uniform bearing that is less likely to settle, thus providing more nearly a permanent surface, eliminates much subsequent spot surfacing and contributes materially to a longer service life of the ties.

Both Methods Have Their Place

By V. H. SHORE

Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

In tamping ties, as with many other items of track maintenance, the method best adapted for doing the work depends upon the conditions under which it is being done. If the track is being given a general surface, and the lift is in excess of one inch, lock tamping can be employed successfully. In this case the surface can be maintained subsequently with as little difficulty as if the tamping had been done on both sides of the tie.

For lock tamping to be successful, however, there must be sufficient lift to insure that the ballast can be tamped from one side in such a manner that it will completely and compactly fill the space under the tie with a moderate amount of effort, and that this can be done without disturbing the old bed. A lift of about 1 in., however, is the minimum at which this is practicable.

If the lift is less than 1 in., the tie should be tamped from both sides, from the end to about 12 in. inside of the rail. On light lifts it is impossible to lock tamp without "humping" the track, pulverizing the ballast or breaking up the old bed, any one of which will result in unsatisfactory track conditions.

Ties Should Have an Even Bearing

By H. BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

It is fundamental in track maintenance that the ties must have an even bearing in order to maintain good line and surface with a minimum of labor. In fact, it is next to impossible to keep good-riding track unless the ties do have such a bearing. In light surfacing, as opposed to a general raise, it is my experience that tamping from both sides is more reliable than lock tamping. The tie can be brought more tightly to the rail; the ballast is packed more uniformly under the tie, so that there is no tendency to rock and less tendency to settle under the wheel loads.

In lock tamping, extreme care must be exercised to secure uniform tamping across the width of the tie. The total amount of effort required to accomplish this is so great that it is seldom done, even with the closest supervision. In chatts, cinders, granulated slag and most gravels, the men can be assigned to work in pairs, tamping simultaneously on opposite sides of the ties. Organized in this manner, they will do a first-class job of tamping in less time than is possible where they are required to shove the ballast across the full width of the tie and compact it uniformly.

Opposite Tamping Gives Better Results

By Assistant District Engineer

A sharp difference of opinion exists as to the best method of tamping ties. Both methods mentioned in the question are used with success in ballasted track. It is probable that the proponents of either of these methods can find convincing reasons to support the use of the method they have adopted.

Personal experience, however, indicates that tamping from both sides tends to compact the ballast more uniformly than cross tamping. In selecting tampers for this method, the foreman should assign men of nearly equal size and strength. This method is somewhat slower and consequently is more expensive than lock tamping. The advantages warrant this larger expense, however, since later maintenance is diminished.

Lock tamping does not give as good or uniform a bearing for the tie, because the tamping is done from one side. Admittedly it is more difficult to push the ballast clear across the face of the tie, so that there is increased danger of disturbing the original bed unless great care is exercised, and it is difficult to be really careful in this respect when tamping ties.

For these reasons, tamping the tie from both sides should give better results in maintaining surface, since in this method the ballast is uniformly distributed and compacted under the bottom of the tie for its full width. In lock tamping, on the other hand, there is great danger that the ballast will be well compacted for only about half the width of the tie on the side from which the tamping is done.

Has Only One Advantage

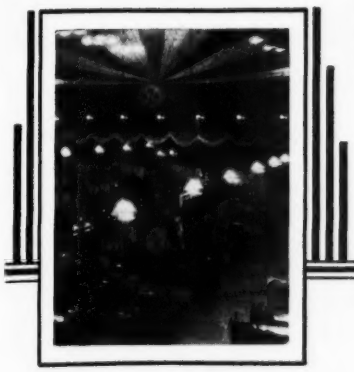
By R. ROSSI

Yard Foreman, Chicago & Alton, Chicago

I have been able to find only one advantage in lock tamping, and that is that where this is practical a gang can complete more work in a given time. Against this, however, must be weighed the disadvantages, among which are: More labor is required to maintain good surface; the track tends to get out of line as quickly as out of surface; the ties seldom have a uniform bearing, so that they tend to split or warp and often break at the ends, even though they are tamped inside of the rail, thus shortening their service life; on rock ballast, the noise of passing trains is more pronounced, often resembling the rumble that accompanies the passage over an open trestle.

There are positive advantages in tamping ties from both sides. Where the tamping is done in this manner, both outside of the rail and for a distance of 12 to 16 in. inside, the tie will have a solid bearing which will maintain a better line and surface for a longer time. No extraordinary strains are put upon the tie, so that there is no tendency to rock, split, warp or break across the grain. For these reasons, less labor is required to maintain the track in good riding condition. I have tried both methods and have watched the results, so that my opinion is based on long experience under many conditions of track maintenance.

A Scene Along the Main Line of the Baltimore & Ohio in West Virginia



NEW AND IMPROVED DEVICES

A New One-Yard Excavator

A FULL-REVOLVING 1-cu. yd. excavator known as the P&H Model 500 has been developed recently by the Harnischfeger Corporation, Milwaukee, Wis. This excavator has been subjected to a series of tests during the last winter and is now being placed on a production basis. In design and construction it is similar to other P&H excavators, with a number of added refinements.

The main frames consist of unit alloy steel castings while the wearing parts are of alloy heat-treated steels. The drums are located in tandem and operate through the P&H power clutch control. A minimum number of gear reductions contribute to the simplicity of the machine. Power may be supplied from gasoline, Diesel or electric motors, whether the machine is operated as a shovel, dragline, crane, clamshell, hoe, or skimmer.

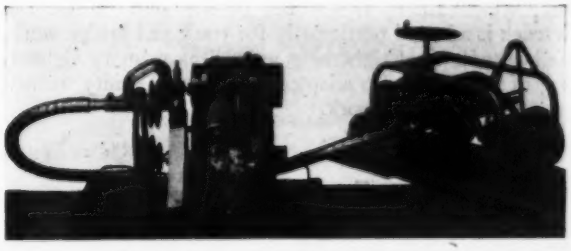
The corduroy (crawler) frames are cast from alloy steel and are bolted directly to the carbody. These crawlers employ the P&H double sprocket drive and engage the link pins directly. The weight of the machine is distributed through the corduroy shoes to the ground by 12 pairs of alloy heat-treated rollers. Corduroy shoes of different widths can be provided to meet varying conditions of the ground.

The P&H Model 500 as a Shovel

The shovel boom is of box-section construction and the P&H chain crowd with fast return is used. The dipper has a manganese steel front and renewable and reversible teeth. The dragline and crane booms are of trussed structural design, and when it is equipped for dragline operation the machine handles the dipper on a 40-ft. boom. As a crane with the same length of boom, the machine is rated at 31,700 lb. at a 12-ft. radius, which is 75 per cent of the tipping load. The entire machine is finished in dark green enamel, and a fully-enclosed steel cab is standard.

Develops Portable Grinding Outfit

A SMALL portable grinder for use in connection with the building up of battered rail ends by either gas or electric arc welding has recently been placed on the market by the Syntron Company, Pittsburgh, Pa. The equipment consists of a single-cylinder, air-cooled gasoline engine mounted on a sled-like frame and weighing about 100 lb. This engine is of such a size that it can be set in the space between tracks with sufficient clearance for passing trains. The grinding wheel is connected to the engine drive by means of a flexible shaft that is of sufficient length to reach to the opposite rail. The end of the shaft has a special connection that plugs into the grinding wheel, being locked with a single turn.



The New Syntron Portable Grinding Outfit

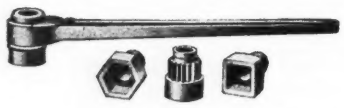
The Syntron rail grinder itself consists of a grinding wheel mounted in a light tubular frame which is supported on two double-flanged dolly wheels. This carriage weighs 50 lb. The flexible shaft from the engine drive connects directly to one end of the grinding wheel shaft. A vertical screw feed is provided to raise or lower the grinding wheel and a similar feed is employed to move the wheel horizontally across the rail and down over each side. The movement of the grinder longitudinally with the rail is done by means of the dolly wheels. It is said that a perfectly straight edge surface on the welded rail ends can be obtained by tilting the

carriage to follow the contour of the rail as it is moved back and forth.

In addition to the grinding carriage, the flexible shaft can be fitted with a hand-operated wheel provided with a safety guard for beveling the rail ends and for grinding down the old rail to expose the clean parent metal before welding. The entire outfit serves three purposes, preparing the old rail, grinding the rail to a true straight edge surface and beveling the rail end.

New Reversible Ratchet Wrench

A NEW reversible ratchet wrench, known as the Safety-Steel wrench, has been put on the market by the Lowell Wrench Company, Worcester, Mass., which involves several distinct features and which, because of special metals used in its construction, is suitable for the most severe classes of work. The new wrench has a 24-in. handle with interchangeable sockets, which make it suitable for use on bolts ranging from ⅝ in. to 1¼ in. in diameter, with square or hexagonal nuts from 1¼ in.



New Reversible Safety-Steel Wrench With Changeable Sockets

to 2 in. across the flats. The handle is made of electrically-treated metal and has been provided with an improved grip which is said to be easier on the hands of the operator. The new wrench has pawls of hardened steel, which are so inclosed that little or no dirt can get into the operating parts, and the pawl mechanism is so developed that it is subject only to crushing stress.

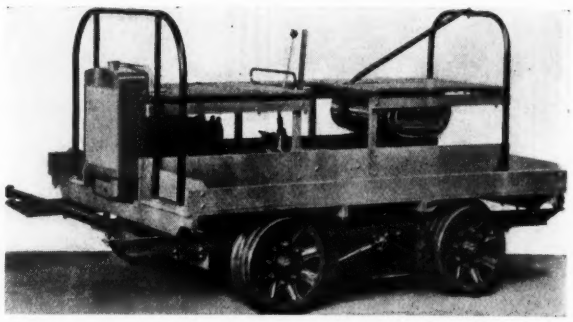
The wrench can be reversed without being removed from the work by simply throwing a small shipper or reversing lever near the end of the handle. The sockets are removable and interchangeable by simply taking off a retaining collar on the back side of the socket piece in use, which allows the socket to slip out. While the wrench is adapted particularly for track and bridge work, and permits final tightening as well as primary tightening of nuts, it is also adapted as a general utility wrench in a wide range of work.

New Fairmont A3 Car

FAIRMONT Railway Motors, Inc., Fairmont, Minn., have recently developed a new motor car known as the A3, which is similar in a number of respects to this company's A6 large extra-gang car, although somewhat smaller. The new car is designed particularly for hauling bridge and building crews, extra gangs and weed mowers, for use around large yards, and for other service where quick reversibility and rapid acceleration are required for avoiding traffic.

This car is equipped with a four-speed truck-type transmission, a Borg & Beck clutch, a propeller shaft drive and a Fairmont ball and roller bearing rear axle reverse gear. The four different gear reductions are said to insure the quick starting of heavy loads, with rapid acceleration by shifting to higher gears. Any of the speeds is suitable for constant use, as all the gears are hardened and are mounted on ball or roller bearings throughout. They also run in transmission grease. As soon as the car is brought to a stop, all four transmission speeds are available for running backward as well as forward.

The A3 has a four-cylinder ball-bearing engine with a horsepower of from 7 to 15, at from 900 to 2,000 r. p. m. Maximum engine speed is automatically limited



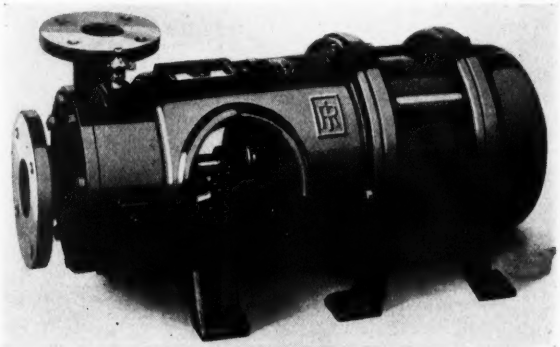
The New Fairmont A3 Car

by a ball-bearing governor to any setting desired. Lower speeds are controlled by a hand throttle. The car is equipped with 13 ball bearings and 10 Hyatt, 2 Timken and 4 Bower roller bearings.

This car has the same auto-type driver's cockpit as the A6 car. The four-wheel, self-centering brake shoes are lined with Raybestos and are operated from a single lever. The total weight of the car with 16-in. wheels is 1,365 lb., while the lifting weight at the rear end is 292 lb. The moving of the car across high rails is facilitated by rail skids. The car has seating space for about 10 men.

New Line of General Service Centrifugal Pumps

A NEW line of Cameron general service, electric motor-driven centrifugal pumps of small and medium capacities for operating against heads up to 100 ft., have been put on the market by the Ingersoll-Rand Company, New York City. These pumps, which are desig-



A New Cameron General Service Centrifugal Pumping Unit

nated as Class RV units, are single-stage, single-suction, enclosed-impeller centrifugal pumps with direct motor drive. They are self-contained, compact portable units, and it is said that they incorporate a number of features which insure efficient operation with a minimum of maintenance and attention.

The pump casing is a separate iron casting with an in-

tegral discharge nozzle, which can be assembled in any one of four positions. The suction nozzle is also a separate iron casting and can be removed to give full access to the interior of the pump. The impeller is of the enclosed type, cast of bronze in one piece, and is balanced hydraulically by means of several holes through the impeller hub. Renewable stationary wearing rings of a special bronze seal the impeller hubs against leakage.

One shaft of large diameter and made of heat-treated open hearth steel, carries both the pump impeller and the driving motor rotor. This shaft is protected by a bronze sleeve where is passes through the stuffing box.

Two large sets of ball bearings support the rotor, one of these having large thrust capacity to take care of any unbalanced thrust of the impeller. The bearings are mounted in dirt- and grease-tight cartridge-type housings, which permit the removal of the rotor for inspection without disturbing the bearings.

The motor is a General Electric type, designed to withstand severe temperatures and surrounding air conditions, and to resist oil, moisture and corrosive elements.

Improves Rail-Laying Crane

THE Parsons Company, Newton, Iowa, has recently effected a number of improvements in its No. 5 crane to adapt it more fully to the efficient laying of rail. Among other improvements, the telescopic boom has been strengthened, the swinging gear has been reinforced and addtional bracing has been introduced at the bottom of

The Parsons No. 5 Crane

the boom. The unit has been equipped with a heavier clutch for high-speed traction and also to increase the power of the crane for switching cars. In addition an end bumper designed to engage the regular standard gage M. C. B. bumper is now supplied as extra equipment. The cast iron worm gear has been replaced with steel gear, and the governor of the engine has been equipped with an improved hand control to enable the operator to alter the speed of the engine when the machine is being used for high speed transportation. A new oiling device for the general bearings has been placed where it is accessible from the top of the platform.

What Our Readers Think

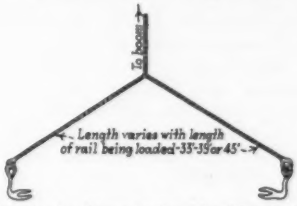
Loading Rails

St. Paul, Minn.

TO THE EDITOR:

I was much interested in reading the replies to the question about the best method for loading rail, which appeared on page 473 of the May issue. I was considerably surprised, however, at the uniformity with which your respondents stated that three men are required on the ground and three in the car, in each case one man being assigned to handle the tongs and two to steady the rail.

For some time we have used a spreader arrangement, as illustrated, with end hooks instead of tongs. With this device we are able to get along nicely with two men



Sketch of a Spreader for Handling Rail

on the ground and two in the car. Short ropes can be attached to the end hooks for the purpose of steadying the rail during its movement from the ground to the car.

An advantage of this method is that the hooks can engage the fillet of either the head or the web, so that, if the rail is lying on its side or head, it does not have to be turned up as is necessary when using tongs.

G. L. SMITH,
Engineer of Track, Great Northern.

New Books

A Text on Lumber

LUMBER AND ITS USES, Fourth Edition, by Royal S. Kellogg, 378 pages. 8½ by 5½ in. Bound in cloth. Published by Scientific Book Corporation, 15 East Twenty-Sixth Street, New York. Price $4.

This is the fourth edition of a work that appeared for the first time in 1914 and has been revised and enlarged to conform with the advance in the knowledge of lumber and its uses. The book embraces chapters covering the structure of wood, its physical properties, lumber grading, American Lumber Standards, seasoning, wood-preservation, paints and fire resistance, which are of general interest, and chapters on forest products, building construction, planing mills, factory uses and lumber operations which have a more specialized appeal. A chapter on Commercial Woods briefly describes and catalogs the use of 52 species of wood. The treatment as a whole may be described as general. Railway cross-ties are dismissed with a word. The discussion of wood preservation is very brief and twice as much text matter is allotted to open-tank treatment as to pressure treatment. The value of the text to the railway reader lies primarily in treatment of lumber as a material of construction.

NEWS OF THE MONTH

Class I Railways Capitalized at Nineteen Billions

The total capitalization of the Class I railways of the United States at the close of 1930, was $19,301,352,139, an increase of $472,228,722 as compared with 1929, according to a preliminary compilation of the Bureau of Statistics of the Interstate Commerce Commission. Of the total capitalization, $8,250,000,295, or 42.7 per cent, was capital stock and $11,051,352,139, or 57.3 per cent, was long-term debt.

Columbian of Baltimore & Ohio Now Air Conditioned

The first train to be entirely air-cooled and air purified was placed in service on May 20 on the Baltimore & Ohio. This train is the "Columbian" running between New York, Philadelphia, Baltimore and Washington. All of its equipment, consisting of a smoking lounge car, observation sun-room car, latest type parlor cars, individual seat coaches, and colonial dining car, is equipped with the air-conditioning system.

Order Study of Rate Structure

A resolution directing the heads of the traffic departments of the railroads to make a thorough examination of the freight rate structure with a view to ascertaining what revisions can be made to regain the revenue lost by the carriers during recent years was adopted by the Association of Railway Executives at its spring meeting at Chicago on May 8. The considerable expense of valuation accounting was among the other things discussed at the meeting.

Co-ordinated Service Planned by Pennsylvania

Freight service whereby loaded truck bodies will be transported between centers of population by rail is contemplated by the Pennsylvania which in the near future intends to ask authority to establish such service in co-operation with existing truck lines, according to Elisha Lee, vice-president. A study of the conditions between New York and Philadelphia, Pa., has shown that it costs truck operators 30 cents a mile to operate loaded trucks with 20-ft. bodies, while the railroad can perform the same service remuneratively for 15 cents a mile, according to Mr. Lee. In this service the truck operator will handle the shipment between the door of the shipper or consignee and the rail station while the railroad will handle the truck bodies between cities.

Court Grants Injunction Against Grain Rates

Acting on a petition filed by the Western railroads, including 72 individual companies,, the United States District Court at Chicago on May 7 granted a temporary injunction restraining the Interstate Commerce Commission from placing its order revising rates on grain and grain products into effect for a period of 60 days. This action extends the effective date of the order from June 1 to August 1.

Penna. Lays First 152-lb. Rail

The first rail of the Pennsylvania's new 152-lb. section to be placed in service was laid near Tyrone, Pa., on May 20. This section was recently adopted for use in the heaviest traveled main-line tracks of the Pennsylvania, and the rail now being laid is the first of an experimental order which is to be placed in service at points between Pittsburgh, Pa., and Harrisburg, and between New York and Philadelphia, Pa. This rail is rolled in lengths of 39 ft. and is handled by crane from a rail-laying train carrying a crew of 64 men. In addition this crew is augmented by a force of 20 trackmen regularly assigned to this territory. The rail now being laid was rolled by the Bethlehem Steel Company.

Success of Low Rates Varies

The recent policy of the railroads of offering excursion passenger fares of about one cent a mile has met with varying degrees of success in different sections of the country. The Southern Pacific on two occasions has offered a round-trip fare equal to three-fifths of the one-way rate and each time has been rewarded with such a large increase in business that it has decided to try the rate again. On the other hand the 12 western roads that offered round-trip tickets between practically all stations for about one cent a mile on April 24 and 25 experienced only a slight increase in traffic on those days, at the same time suffering a marked decline in ticket sales on the days immediately preceding and following the excursion dates. Similar excursion rates recently offered by a number of eastern roads proved unusually successful and developed a substantial amount of business. A significant feature of these excursions is the fact that 60 per cent of the patrons of sleeping cars were using this type of accommodation for the first time.

March Freight Traffic Figures Show Decline

Freight traffic moved by the Class I railroads in March amounted to 29,960,291,000 net ton-miles, a reduction of 15.1 per cent under March, 1930, and of 25.5 per cent under March, 1929, according to reports compiled by the Bureau of Railway Economics. For the three months ending with March the total net ton-mileage was 87,390,190,000, a reduction of 17.9 per cent under the first quarter of 1930, and of 25.7 per cent under the corresponding period in 1929.

Net Income of Class I Railways Slumps in First Quarter

The net railway operating income of the Class I railways of the United States in the first three months of 1931 was $107,098,448, which was at the annual return of 2.07 per cent on their property investment, as compared with a net of $176,542,859, or 3.48 per cent, in the first quarter of 1930, according to reports compiled by the Bureau of Railway Economics. Operating revenues for the first three months totaled $1,078,680,915, a decrease of 19.1 per cent as compared with a revenue of $1,332,555,118 for the same period in 1930. Operating expenses decreased 17.4 per cent to $857,779,853. Taxes amounted to $82,027,350, a decrease of 7 per cent.

Production of Track Fastenings Shows Decrease in 1930

The production of angle bar rail joints in the United States in 1930 totaled 116,754 gross tons compared with 194,225 gross tons in 1929. The production of tie plates in 1930 totaled 427,446 gross tons compared with 603,758 gross tons in 1929, or a reduction of 29.3 per cent. However, this total includes both steel and iron tie plates from 47,713 gross tons to 27,547

gross tons was proportionately larger, or a decrease of 42.2 per cent. The production of fish plates and other rail joints during 1930 totaled 19,223 gross tons, or a slight decrease from the total of 20,629 tons produced in 1929.

Southwestern Roads Get Lower Rates on Automobiles

On May 5 the Interstate Commerce Commission made public a supplemental order in which it authorized the southwestern roads to disregard prescribed relationships between rates on automobiles on hauls up to 500 miles. This report was in response to the petition of these roads asking that they be permitted to establish reduced rates on automobiles for the purpose of meeting the increasing competition of motor trucks in the shipping of automobiles from manufacturing and distributing points.

New Equipment Statistics

In the first three months of the year, Class I railroads placed 3,855 new freight cars in service as compared with 24,798 in the same period last year, according to the Car Service division of the American Railway Association. In the same period these roads placed 34 new locomotives in service as against 189 last year. On April 1 the railroads had 7,516 new freight cars on order, compared with 37,117 on the same date last year. New locomotives on order on this date totaled 86 as contrasted with 442 on April 1, 1930.

Frisco Withdraws Two-Cent Fare

The St. Louis-San Francisco, the only road to place in effect a passenger fare of two cents a mile throughout its system, has informed the various railroad commissions of the states through which it passes that on July 1 it will withdraw its two-cent fare, which was established on February 1. The reason given is the fact that passenger revenues have continued to decline during the period this fare has been in effect.

Railroads operating between Chicago and points in California, which established three classes of fares for the period from January 1 to June 30, have individually filed their intention of continuing these fares to October 31. The coach rate of $50 has been reduced to $40. The Chicago, Milwaukee, St. Paul & Pacific and the Chicago & North Western have decided to continue for another period the two-cent passenger fares which they now have in effect on various portions of their lines.

National Safety Council Makes Annual Awards

The 1930 winners of the annual steam railroad accident prevention contest conducted by the National Safety Council were awarded bronze plaques at a dinner held at the Stevens Hotel, Chicago, on May 19. The awards are made for the lowest showing in the number of killed and injured per million man-hours worked. The winners, together with their ratings, are as follows: Group A, Chicago & North Western, 2.69; Group B, Atlantic Coast Line, 1.66; Group C, Oregon Short Line, 2.63; Group D, Mobile & Ohio, 2.7; Group E, Duluth, Missabe & Northern, 2.63; Group F, Staten Island Rapid Transit, 2.96; and Group G, Missouri-Illinois, 2.21. A new classification added this year for switching and terminal companies shows the following winners: Group A, Baltimore & Ohio, Chicago Terminal, 2.54; and Group B, Lake Terminal, 0.00 (no casualties).

Report Further Progress In Consolidation Plan

Further progress toward settling the controversial points in the eastern four-system consolidation plan was attained recently when it was reported that the Pennsylvania and the Van Sweringen interests had reached an agreement as to the extent of the trackage rights to be accorded the Pennsylvania over the Lehigh Valley in reaching the districts of Allentown and Bethlehem, Pa. The question as to the joint control of the Virginian, by stock ownership or lease, by the Norfolk & Western and the Chesapeake & Ohio, as parts of the Pennsylvania and Chesapeake & Ohio-Nickel Plate systems, has also been settled.

Fifteen Roads Do 50 per cent of Total Business

The standings of the 15 roads ranking highest in the amount of freight revenue, passenger revenue and revenue from farm products earned in 1929 is shown graphically on three charts that have been compiled by the Bureau of Statistics of the Interstate Commerce Commission. These charts show that the 15 largest railways, as measured by freight traffic, earned 50.41 per cent of the total freight revenue of Class I railways in 1929. The 15 largest roads with respect to passenger traffic earned 63.52 per cent of the passenger revenue, while the 15 roads ranking highest in the amount of farm products handled earned 56.5 per cent of the revenue from this source. The Pennsylvania heads the list as to both freight and passenger revenues, having earned more than 10 and slightly less than 15 per cent of the total revenues in these two classifications, respectfully. With respect to revenue from farm products, the Atchison, Topeka & Santa Fe was first with a little more than six per cent of the total revenues from this source.

Two States Tighten Regulation of Highway Service

The legislatures of various states continue to enact measures placing commercial highway transportation activities under more stringent regulation. The governor of Missouri has recently signed a bill passed by the general assembly which reenacts virtually all of the regulatory provisions of the motor bus act of 1927, and in addition places both common carriers and contract carrier motor lines under the jurisdiction of the State Public Service Commission. Motor truck and bus lines must secure certificates of public convenience and necessity as prerequisites to operation, and in granting these certificates the commission must give consideration to existing transportation service and to the effect that the proposed highway service would have on the existing service. The house and senate of the Texas legislature have recently both passed two motor truck regulatory bills which, while containing certain conflicting provisions that are now under consideration, regulate the loads of a truck to 7,000 lb. for cross-country movements, and to 19,000 lb. for short distance movements.

Stress "Falls of Persons" in June Safety Program

The Committee on Education of the Safety Section, American Railway Association, has issued circular No. 296, suggesting that railway safety departments place special emphasis in June on the prevention of "Falls of Persons." The circular cites figures of the Interstate Commerce Commission showing that in 1929 the total number of employees killed in train service accidents by "stumbling, slipping or falling" numbered 167, while those injured totaled 6,867. In non-train accidents there were 37 employees killed and 4,717 injured from the same cause.

Installs Rail-Highway-Water Service

Freight service involving a joint movement by highway, steamship and rail has been established by the Pennsylvania between Baltimore, Md., and Salisbury. In this service detachable truck bodies are used, the bodies being loaded at the door of the shipper in Baltimore and moved to the pier by motor, where they are lifted by cranes from the chassis to the deck of the steamer. After the movement across Chesapeake bay, the truck bodies are transferred to railroad cars for the trip to Salisbury, where they are delivered to the door of the consignee by motor truck.

Truck-Competitive Cotton Rates Authorized by I. C. C.

The severity of truck competition in the transportation of cotton from points in the Southern states to Gulf ports has caused the Interstate Commerce Commission to issue a report authorizing the roads concerned to establish experimental truck-competition rates as a means of regaining some of their business that has been lost to trucks. The transportation of cotton to the Gulf ports by truck has been gradually extended until during the season of 1930-31, these operations reached points in Texas 525 miles from Houston. During the season up to January 1, it is estimated that a total of 1,138,935 bales, or 24.25 per cent of all the cotton arriving at Texas ports, were transported by truck, and that in territory where the trucks are active they handle fully 50 per cent of this business. The recent order of the I. C. C. grants the railroads the privilege of disregarding until June 25, 1932, the relation of the rates on cotton as between the various points of origin and the ports in the setting up of truck-competitive rates.

ASSOCIATION NEWS

American Railway Engineering Association

Nine committees and the board of direction of the A. R. E. A. held meetings during the month of May. On May 7 and 8, the Committee on Masonry held a meeting at Cincinnati, while the Committee on Iron and Steel Structures met at Cleveland on the same two days, and the board of direction met in the offices of President L. W. Baldwin at St. Louis on May 7. The Committee on Shops and Locomotive Terminals met at Chicago on May 12 and the Committee on Track met at Chicago on May 13. On the following day, the Special Committee on Waterproofing also met in Chicago, this being the first meeting of this new committee. On May 21, the Committee on Economics of Railway Operation met in Pittsburgh and on May 22, a meeting of the Committee on Standardization, which was attended by Secretary E. H. Fritch, was held at Washington, D. C. On May 26 and 27, the Committee on Wood Preservation met at Ottawa, Ont., while the Committee on Water Service and Sanitation held a meeting at Pittsburgh on May 27.

The Board of Direction of the Electrical Section of the American Railway Association, formerly the Committee on Electricity of the A. R. A. and the A. R. E. A., held a meeting at New York on May 20.

Among the committees which have already scheduled meetings in June are those on Economics of Railway Labor at Pittsburgh on June 5, on Ballast at Cleveland on the same date and on Records and Accounts in the latter city on June 23.

Proofs of a large part of the proceedings of the 1931 convention are now in the hands of the secretary, and it is anticipated that the proceedings will be mailed to the members during the month of July. The June bulletin of the association, which is now in the hands of the printers, will consist largely of monographs on subjects pertaining to the work of the association and, in addition, will contain a complete roster of all of the subcommittees of the various standing and special committees of the association.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be its annual outing, which will be held on June 20 at the Berkeley-Carteret Hotel, Asbury Park, N. J. It is planned that the activities will start about noon, D. S. T. The group from Philadelphia will leave the Broad Street station at 9 a. m. D. S. T., while those leaving New York will go via the Sandy Hook route of the Central Railroad of New Jersey, the boat leaving Pier 10, Cedar street, New York, at 10:30 a. m., D. S. T.

American Wood-Preservers Association

Officers and members of the Executive committee and the chairmen of committees met in Ottawa, Ont., on May 26-27, this point being selected to afford those attending an opportunity also to visit the Canadian Forest Products Laboratory and to observe the investigations under way there.

Roadmasters Association

The Executive committee will meet at the Hotel Stevens, Chicago, on Saturday, June 27, to plan for the forty-ninth annual convention. At that time the chairmen of the various standing committees will submit their reports in tentative form for consideration and discussion and other work of the association will be reviewed.

International Track Supervisors' Club

The last meeting of the International Track Supervisors' Club was held on May 20 at the Hotel Statler, Buffalo, N. Y. The two features of interest were a paper by M. J. Cooney, retired track supervisor of the Erie, on "Selection and Qualifications of a Track Foreman" and a paper, accompanied by a motion picture, on the latest practices in welding manganese track units, presented by M. B. Morrison of the Morrison Railway Supply Corporation.

Directory of Associations

American Railway Bridge and Building Association.—C. A. Lichty, secretary, 319 N. Waller Ave., Chicago. Next convention, October 20-22, 1931, Royal York Hotel, Toronto, Ont.

American Railway Engineering Association.—(Works in co-operation with the American Railway Association, Division IV.)—E. H. Fritch, secretary, 59 East Van Buren St., Chicago. Next convention, March 15-17, 1932, Palmer House, Chicago.

American Wood Preservers' Association.—H. L. Dawson, secretary, 1104 Chandler Building, Washington, D. C. Next meeting January 26-28, 1932, Hotel Jefferson, St. Louis, Mo.

Bridge and Building Supply Men's Association.—S. A. Baber, secretary, High Grade Manufacturing Co., 10418 St. Clair Ave., Cleveland, Ohio. Annual exhibit at convention of American Bridge and Building Association.

National Association of Railroad Tie Producers.—Roy M. Edmonds, secretary, 1252 Syndicate Trust Building, St. Louis, Mo. Next convention in 1932.

National Railway Appliances Association.—C. W. Kelly, secretary, 1014 So. Michigan Ave., Chicago. Annual exhibit at A. R. E. A. convention.

Roadmasters' and Maintenance of Way Association.—T. F. Donahoe, secretary, 428 Mansion Street, Pittsburgh, Pa. Next convention, September 22-24, 1931, Hotel Stevens, Chicago.

Track Supply Association.—L. C. Ryan, secretary, Oxweld Railroad Service Co., Carbon & Carbide Building, Chicago. Annual exhibit at convention of Roadmasters' and Maintenance of Way Association.

During March, 1931, the Missouri-Kansas-Texas, for the first time in its history, operated an entire month without an engine failure. The total mileage of all locomotives in service that month was 930,610.

PERSONAL MENTION

General

R. H. Smith, superintendent of the Radford division of the Norfolk & Western, and formerly a roadmaster on this road, has been promoted to general superintendent with headquarters as before at Roanoke, Va. **W. O. Tracy,** assistant superintendent of the Pocahontas division and at one time a resident engineer on the N. & W., has been promoted to superintendent of the same division, with headquarters as before at Bluefield, W. Va.

Mr. Smith was born on March 10, 1888, at Baltimore, Md., and graduated from Princeton university in 1911, with a degree in civil engineering. During the summer of 1910 and prior to his graduation, Mr. Smith served as chainman in the engineering department of the N. & W. In 1911, he returned to this road as a masonry inspector and

R. H. Smith

served in this position and as a transitman until 1913, when he was promoted to assistant roadmaster. He was advanced to roadmaster at Pulaski, Va., in 1914, being transferred to Roanoke in 1916. In 1917, he was further advanced to assistant superintendent of the Pocahontas division, with headquarters at Bluefield, being transferred to the Radford division at Roanoke in 1919. In 1922, Mr. Smith was promoted to superintendent of this division with the same headquarters, which position he was holding at the time of his recent promotion to general superintendent, effective May 1.

Mr. Tracy was born on May 25, 1885, at Winchester, Ky., and commenced railway service on November 17, 1905, as a rodman on the Pocahontas division of the N. & W. He was advanced to levelman a year later and further to inspector on the Norfolk division in November, 1907. After spending a year in other

WOODINGS
Switch Point Protector

The Woodings Forge & Tool Company of Verona, Pa., have recently introduced a switch point protector which embodies some unusual and novel ideas.

It is made of manganese steel and is designed to fit over the switch point between the reinforcing strap and the number one switch clip. It is quickly installed by removing the clip bolts and the rivets ahead of the No. 1 clip, inserting the protector, replacing the rivets with bolts and replacing the clip bolts. The Woodings Switch Point Protector can be easily renewed and prolongs the life of the switch point indefinitely.

WOODINGS FORGE & TOOL CO.

WORKS AND GENERAL OFFICES

VERONA, PENNA.

lines of work, Mr. Tracy returned to the N. & W. in March, 1909, as a rodman. He was promoted to transitman in October, 1911, holding this position until August, 1913, when he was further promoted to assistant resident engineer on the Pocahontas division. In September,

W. O. Tracy

1915, Mr. Tracy was advanced to resident engineer on the Radford division and four years later he went to the Pocahontas division as assistant superintendent, holding this position until his recent promotion to superintendent, effective May 1.

J. W. Graves, assistant superintendent of the New York division of the Erie, with headquarters at Jersey City, N. J., and formerly division engineer at Buffalo, N. Y., has been promoted to superintendent of the Wyoming division, with headquarters at Dunmore, Pa.

Engineering

F. W. Kasten has been appointed chief engineer of the Detroit, Toledo & Ironton, with headquarters at Dearborn, Mich.

Fred Evans, assistant to the division engineer of the Philadelphia Terminal division of the Pennsylvania, has been promoted to assistant engineer on the same division, with headquarters as before at Philadelphia, Pa.

E. H. Shipman, chief engineer of the Lehigh & New England and corporate engineer of the Lehigh Coal & Navigation Company, has moved his office from Bethlehem, Pa., to Allentown.

Following the consolidation of the Torreon and Chihuahua divisions of the National of Mexico on May 1, **Julian Montanez,** division engineer of the former division, with headquarters at Torreon, Coah., has had his jurisdiction extended to include the Chihuahua division. The jurisdiction of **Carlos Corral,** division engineer of the Aguascalientes division, with headquarters at Aguascalientes, Ags., has been extended to include the Durango division, following the consolidation of these divisions on May 1.

Following the consolidation of the Beaumont and Terminals divisions of the Southern Pacific Lines in Texas and Louisiana under the name of the Houston division, **G. A. Boyer,** division engineer of the former Beaumont division, has been appointed division engineer of the new division, with headquarters as before at Houston, Tex. **W. Bretschneider,** division engineer of the former Terminals division, has been appointed assistant division engineer of the Houston division, retaining his headquarters at Houston. **R. G. Schultz,** assistant engineer of the former Terminals division at Houston, has been appointed assistant engineer on the new division, with the same headquarters.

Frank R. Layng, assistant chief engineer of the Bessemer & Lake Erie, has been promoted to chief engineer, with headquarters as before at Greenville, Pa., succeeding **Henry T. Porter,** retired. **H. H. Harman,** engineer of bridges and buildings at Greenville, has been appointed engineer of track with the same headquarters, and **G. G. Martin,** senior supervisor of track, has been appointed assistant engineer, with headquarters also at Greenville. **M. F. Mannion,** statistician at this point, has been appointed assistant to the chief engineer. The positions of assistant chief engineer, senior supervisor and statistician have been discontinued.

Mr. Layng was born on September 9, 1878, at Salem, Ohio, and was educated at the University of Pennsylvania. He entered railway service on October 1, 1897, as a rodman on the Buffalo & Al-

Frank R. Layng

leghany division of the Pennsylvania and was advanced to draftsman on December 1, 1902. He was further advanced to engineer of bridges three years later and then to engineer of track on May 1, 1906. Mr. Layng retained this position until the latter part of 1926, when he was promoted to assistant chief engineer, which position he held until his recent promotion, effective May 1.

Mr. Porter was born on January 10, 1859, at Piedmont, W. Va., and was graduated from Baltimore City College in 1880. He entered railway service with the Baltimore & Ohio in March, 1881, on the extension from Baltimore to Philadelphia. Later in that year he became transitman and assistant engineer on the New York, West Shore & Buffalo, and in April, 1884, he went with the West Virginia Central & Pittsburgh. In May of that same year he went to the South Penn railroad. During 1885 and 1886 he was contractor's engineer on the Howard University Terminal, at Washington, D. C. and then became resident engineer

Henry T. Porter

and general roadmaster on the Toledo, St. Louis & Kansas City, now part of the Nickel Plate System. In August and September, 1897, he was employed on a railroad in Illinois, and then became connected temporarily with the Continuous Rail Joint Company of America. Later in 1897 he became engineer maintenance of way of the Pittsburgh, Bessemer & Lake Erie, and in 1898 he was promoted to chief engineer of the Bessemer & Lake Erie, which position he was holding at the time of his retirement. From 1902 to 1906, Mr. Porter also acted as chief engineer in charge of location and construction of the Western Allegheny railroad.

F. A. Jones, division engineer of the Kansas City Terminal division of the Missouri Pacific, with headquarters at Kansas City, Mo., has been transferred to the Little Rock division, with headquarters at McGehee, Ark., succeeding **A. B. Chaney.** Mr. Chaney becomes division engineer of the Memphis division and of the Union Railway (part of the Missouri Pacific), with headquarters at Wynne, Ark., succeeding **C. J. Jaeschke** and **K. G. Williams,** respectively, with headquarters at Wynne and Memphis, Tenn., who have been assigned to other duties. The position of division engineer of the Kansas City Terminal division has ben discontinued and **V. C. Halpin,** division engineer of the Central Kansas division, with headquarters at Osawatomie, Kan., has had his jurisdiction extended to include the former division.

B. R. Kulp, division engineer of the Madison division of the Chicago & North Western at Madison, Wis., has been promoted to principal assistant engineer, with headquarters at Chicago, a newly created position. **R. W. Richardson,** division engineer of the Northern Iowa and Sioux City divisions at Sioux City, Iowa, has been transferred to the Madison division, succeeding Mr. Kulp. **E. C. Vandenburgh,** supervisor of

Will Not Slip or Loosen

THE *great holding power* of the UNIT ANTI-CREEPER is making a big hit with engineers and supervisors throughout the country. It has solved the problem of creeping track at a minimum cost per mile.

The UNIT ANTI-CREEPER will not loosen and become inoperative when rails slack back. It will carry the tie in any kind of ballast without slipping.

It is the only one-piece anchor with a take-up.

THE CREEPCHECK CO., INC.
WOOLWORTH BUILDING NEW YORK

THE UNIT ANTI-CREEPER

bridges and buildings at Madison, has been promoted to division engineer of the Northern Iowa and Sioux City divisions, to replace Mr. Richardson.

Mr. Kulp has been in the service of the North Western for 26 years. He was born at Duncannon, Pa., on December 16, 1883, and attended the public schools at Harrisburg, Pa. After graduating from Rensselaer Polytechnic Institute in 1905, he obtained his first railroad experience as an instrumentman on the Galena division of the North Western. Later he was advanced to draftsman and to assistant engineer of maintenance on that division, and in 1909 he was transferred to the terminal improvements at Clinton, Iowa. During 1910 and 1911 he served as assistant engineer on the yard improvements at Proviso, Ill., and in 1912 he was promoted to division engineer of the Ashland division at Antigo, Wis. Mr. Kulp was appointed trainmaster on

B. R. Kulp

the Southern Illinois division at Benld, Ill., in 1917, where he remained until 1918, when he was transferred to the Galena division at Chicago. In 1920 he returned to the engineering department as division engineer of the Madison division, where he remained until his promotion to principal assistant engineer, effective May 1.

Mr. Vandenburgh was born on March 26, 1887, at Audubon, Iowa, and graduated from Iowa State College in 1908. He entered railway service on July 1, 1908, in the engineering department of the C. & N. W. and has been with that road continuously. He served as a chainman, rodman, draftsman, and instrumentman on location, construction and maintenance until October 7, 1912, when he was transferred to the signal department as an inspector. A year later he was advanced to chief draftsman in the same department. From July 11, 1914, to January 1, 1916, Mr. Vandenburgh served as assistant engineer on construction, returning to the signal department as assistant engineer on the latter date. Two years later he was appointed assistant general bridge inspector, which position he retained until April 7, 1924, when he became supervisor of bridges and buildings of the Madison division at Madison, Wis. He retained this position until his recent promotion to division engineer, effective May 1.

Following the consolidation of the five operating districts of the Chicago, Burlington & Quincy into three, known as the Western, Central, and Eastern districts, there has been a general rearrangement of district engineers on this road. The Western district consists of the former Wyoming and Nebraska districts and **G. F. Hamilton,** district engineer of the former, with headquarters at Alliance, Neb., has been appointed district engineer of the Western district, with headquarters at Lincoln, Neb. **W. H. Eiker,** district engineer of the Nebraska district, with headquarters at Lincoln, Neb., has been assigned to other duties. The newly created Central district consists of the former Missouri and Iowa districts and **E. H. Peck,** district engineer of the former, with headquarters at St. Louis, Mo., has been assigned to the Central district, with headquarters at Burlington, Iowa. **G. A. Laubenfels,** district engineer of the former Iowa district, with headquarters at Burlington, has been assigned to other duties. The new Eastern district is made up of the former Illinois district with but slight change in mileage, and **R. W. Willis** continues as district engineer of the renamed district, with headquarters as before at Chicago.

A. F. Bradford, assistant engineer on the Missouri Pacific at St. Louis, Mo., has been transferred to Wynne, Ark., succeeding **H. H. Heasley,** who has been transferred to Falls City, Neb.

W. G. Powrie, whose promotion to division engineer of the Iowa & Southern Minnesota division of the Chicago, Milwaukee, St. Paul & Pacific, was noted in the April issue, was born on August 5, 1904, at Milwaukee, Wis. His first railway service was with the C. M. St. P. & P. in 1920, when he served for three months. He returned to the service of this road in 1923 as a chainman in the district engineer's office at Minneapolis, Minn., and was advanced successively through the positions of rodman and instrumentman. In 1928, Mr. Powrie was promoted to assistant engineer at Mason City, Iowa, and on January 1, 1930, was appointed assistant to the general supervisor of bridges and buildings at Chicago, which position he held until his recent promotion to division engineer. Mr. Powrie's headquarters are at Austin, Minn.

Track

J. Crahen, supervisor of track on the Memphis division of the Illinois Central, with headquarters at Memphis, Tenn., has retired from active service.

J. F. Shea, supervisor of track on the Chicago & Eastern Illinois, with headquarters at Salem, Ill., has been transferred to Dolton, Ill., where he succeeds **B. Clark,** who has been assigned to other duties. The position of supervisor at Salem has been discontinued.

J. A. Rohrer, roadmaster on the Atchison, Topeka & Santa Fe, with headquarters at Wickenburg, Ariz., has been transfered to Prescott, Ariz., succeeding **F. Rahmgren,** who has been assigned to other duties. The position of roadmaster at Wickenburg has been abolished.

H. H. Leathers has been appointed acting roadmaster on the Canadian National, with headquarters at Portage La Prairie, Man., to succeed **F. McInnery,** deceased. **P. Harrison** has been appointed acting roadmaster at The Pas, Man., succeeding **J. Brannan,** resigned.

H. G. Kornegay has been appointed roadmaster on the Southern Pacific Lines in Texas and Louisiana, with headquarters at Lufkin, Tex., succeeding **R. L. Tuck,** who has been transferred to Houston, Tex., where he succeeds **L. Stepleton,** who had retired and whose death is noted elsewhere in these columns.

R. F. P. Bowman, roadmaster on the Canadian Pacific, with headquarters at Empress, Alta., has been transferred to Aldersyde, Alta., succeeding **T. Edmundson,** who has in turn been transferred to Empress. **G. L. Thorne,** track foreman at Rugby, Man., has been appointed roadmaster temporarily at Broadview, Sask., where he relieves **A. Rois.**

F. G. Smith, supervisor on the New York Central, with headquarters at Clearfield, Pa., has been transferred to Kingston, N. Y., succeeding **George Baerthlein,** who, in turn, has been transferred to Pier 83, North River, New York, to succeed **W. Ruth,** deceased.

F. G. Adams, Jr., assistant on the engineer corps of the Philadelphia Terminal division of the Pennsylvania, with headquarters at North Philadelphia, Pa., has been promoted to assistant supervisor, with headquarters at Hollidaysburg, Pa., to succeed **C. B. Holley,** who has been transferred to Media, Pa. Mr. Holley succeeds **C. J. Webb,** who has been transferred to the Williamsport division, with headquarters at Millersburg, Pa. **R. B. Harris,** supervisor, with headquarters at Shamokin, Pa., has been transferred to the office of engineer, Baltimore improvements, with headquarters at Baltimore, Md.

Following the elimination of the position of general supervisors of road at Pittsburgh, Pa., and Baltimore, Md., on the Baltimore & Ohio, **T. F. Donahoe,** general supervisor at Pittsburgh has been appointed supervisor of subdivision No. 2 of the Pittsburgh division, replacing **E. H. Nichols** who is on leave of absence on account of ill health. **A. G. Zepp,** general supervisor at Baltimore has been appointed supervisor, with headquarters at the same point, suceeding **W. F. Berrett** who has retired on pension. The position of master carpenter at Baltimore held by **R. Jamieson** has been abolished and his duties have been taken over by **E. J. Clopton,** assistant division engineer. **W. E. Kearfott,** assistant division engineer at Keyser, W. Va., has been appointed master carpenter at Connellsville, Pa., succeeding **W. E. Love,** who has retired on pension. **I. S. Sponseller,** general supervisor of road, has taken over Mr. Kearfott's duties as assistant division engineer.

GEO

insures DOUBLE SATISFACTION

GEO..the modern solution to track problems . . guarantees satisfaction from two distinct angles. For the passenger is provided smooth and practically noiseless track, greater speed and greater safety. This should be reason enough to dictate the selection of GEO. What is more important than passenger satisfaction? Yet this modern method of track construction has many other points of superiority. Control of rail movement, reduction in rail wave motion, longer life of rails and ties, radically reduced maintenance costs . . . . these are advantages which maintenance of way men cannot afford to overlook.

G E O is not a new, experimental device. Many thousands of miles of G E O track have been laid in Europe during the past five years and new construction is adding several thousand miles yearly. Here in America, test sections on leading railroad systems are demonstrating G E O to be the most important contribution to railroad track construction of the past decade.

Descriptive literature will be sent at your request, and Carnegie Engineers are at your service at all times.

GEO TRACK CONSTRUCTION

CARNEGIE STEEL COMPANY - PITTSBURGH

Subsidiary of United States Steel Corporation

143

Bridge and Building

C. N. Billings, assistant engineer on the Southern Pacific Lines in Texas and Louisiana, with headquarters at Houston, Tex., has been appointed supervisor of bridges and buildings of the Victoria division, with headquarters at Victoria, Tex., where he succeeds **W. T. Sprague,** transferred.

F. G. Fiske, bridge inspector on the New York Central, with headquarters at Watertown, N. Y., has been promoted to assistant supervisor of bridges and buildings with the same headquarters, succeeding **E. E. Tanner,** who has been transferred as assistant supervisor to Malone, N. Y., where he succeeds **E. R. Pattershall.** Mr. Pattershall has been appointed supervisor of structures on the electric division, with headquarters at New York, succeeding **F. B. Doolittle,** resigned.

I. Olson, supervisor of bridges and buildings on the Chicago & North Western, with headquarters at Casper, Wyo., has been transferred to Sioux City, Iowa, where he succeeds **R. D. Ransom,** who has been transferred to Madison, Wis., replacing **E. C. Vandenburg,** whose promotion to division engineer is noted elsewhere in these columns. The position of supervisor of bridges and buildings at Casper has been discontinued.

J. S. Ekey, supervisor of structures of the Bessemer & Lake Erie, has been appointed engineer of bridges and buildings, with headquarters as before at Greenville, Pa., succeeding **H. H. Harman,** whose appointment as engineer of track is noted elsewhere in these columns. **R. Ridge,** field engineer, has been

J. S. Ekey

promoted to supervisor of structures to succeed Mr. Ekey. The position of field engineer has been discontinued.

Mr. Ekey was born on March 8, 1879 at Pittsburgh, Pa. and graduated from Allegheny College in 1902. He entered railway service in the engineering corps of the Pittsburgh & Lake Erie in June, 1902, and in November, 1903, left that road to enter the engineering department of the city of Pittsburgh. In June, 1906, he became chief construction engineer of the Meadville & Conneaut Lake Traction Company at Meadville, Pa., and in February, 1910, became assistant engineer of the Pittsburgh Flood Commission, at Pittsburgh. In November of that same year he became a draftsman for the city of Pittsburgh and in April, 1914, he was appointed city manager of Grove City, Pa. In June, 1916, he entered the valuation department of the Bessemer & Lake Erie, and in October, 1919, he became supervisor of structures on that road with headquarters at Greenville, Pa.

A. C. Price, acting bridge and building master on the Trenton division of the Canadian Pacific, with headquarters at Toronto, Ont., has been promoted to bridge and building master with the same headquarters, succeeding **R. J. O'Hearn,** deceased. Mr. Price was born on November 6, 1899, at Mountain Grove, Ont., and after a public school education entered railway service in June, 1917, as a bridgeman on the Canadian Pacific. In July, 1924, he was promoted to bridge foreman on the Trenton division, which position he held until October 31, 1930, when he was appointed acting bridge and building master on the same division.

W. R. Langston, whose promotion to bridge and building supervisor on the Louisiana & Arkansas, with headquarters at Minden, La., was noted in the May issue, was born on January 22, 1881, at Wesson, Ark. After a public school education he entered railway service in May, 1903, in the bridge and building department of the Chicago, Rock Island & Pacific. He remained with this road until January, 1910, when he resigned to become a bridge and building foreman on the L. & A. Two years later he left this road to engage in other work, but returned on January 15, 1918, and served in various capacities until his recent promotion to bridge and building supervisor.

Obituary

W. Ruth, supervisor on the New York Central, with headquarters at Pier 83, North River, New York, died on April 12.

L. Stepleton, who retired recently as roadmaster on the Southern Pacific Lines in Texas and Louisiana, with headquarters at Houston, Tex., died on May 5.

A. Bruner, formerly assistant engineer on the Norfolk & Western, who was retired on February 1, 1929, died on March 27. Mr. Bruner was born on January 9, 1859, at Columbia, Pa., and after receiving his higher education at the University of Pennsylvania and Lehigh University, he immediately entered railroad work. He started service with the Norfolk & Western on January 1, 1888, as assistant supervisor in the engineering department and was promoted to assistant engineer on July 1, 1888, continuing in this capacity until his retirement.

J. F. McNally, assistant superintendent of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters at Emporia, Kan., and formerly a roadmaster on this road, was instantly killed on April 8 when struck by a passenger train.

J. L. Jensen, roadmaster on the Illinois division of the Chicago, Rock Island & Pacific, with headquarters at Rock Island, Ill., died on April 14 at Moline, Ill., from pneumonia.

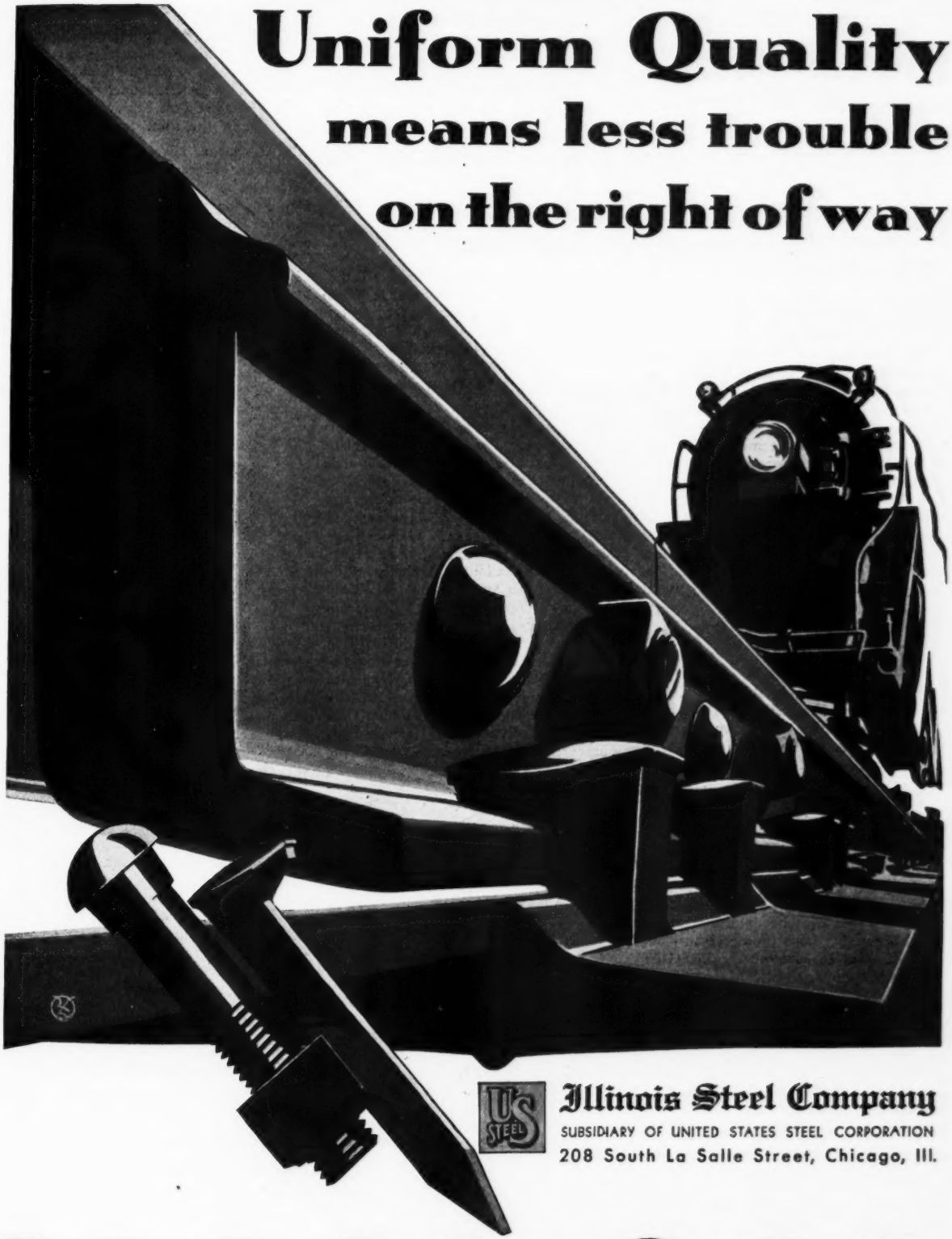
Ross Malcomb Stubbs, bridge engineer of the Missouri-Kansas-Texas at St. Louis, Mo., died suddenly at St. John's hospital in St. Louis, on April 19. Mr. Stubbs was born on February 1, 1886, at Terre Haute, Ind., and attended the public schools of his native city, later obtaining his degree in civil and electrical engineering at the Rose Polytechnic

Ross Malcomb Stubbs

Institute. He had been in the continuous service of the M-K-T for 13 years, having commenced service in St. Louis on August 1, 1918, as assistant bridge engineer. On March 1, of the following year he was appointed bridge engineer at Dallas, Tex., and a year later was transferred to St. Louis. Prior to his connection with the Katy, Mr. Stubbs had been assistant bridge engineer for the Vandalia railroad (now part of the Pennsylvania).

A. Yappen, assistant engineer of bridge maintenance of the Chicago, Milwaukee, St. Paul & Pacific, whose death was noted in the May issue, was born in Schleswig, Denmark, on November 5, 1860, and came to this country as a boy. He graduated from the University of California with a degree in engineering in June, 1882, and in the same year entered railway service as a rodman on the Northern Pacific. After advancing through the positions of instrumentman and assistant engineer, he engaged in other engineering work which took him from South America to Alaska. In 1892, Mr. Yappen took up service with the Milwaukee, serving in various positions in the bridge and building departments and later as assistant engineer on construction work. In 1900, he was promoted to district carpenter at Green Bay, Wis., subsequently being transferred to Chicago. He was promoted to assistant engineer of bridge maintenance at Chicago in 1919.

Uniform Quality means less trouble on the right of way



Illinois Steel Company
SUBSIDIARY OF UNITED STATES STEEL CORPORATION
208 South La Salle Street, Chicago, Ill.

ILLINOIS
TRACK MATERIALS

SUPPLY TRADE NEWS

General

The Dardelet Threadlock Corporation, New York, has granted licenses to the **Colorado Fuel & Iron Company,** for the manufacture and sale of track and commercial bolts and nuts formed with the Dardelet self-locking thread.

The International Derrick & Equipment Company, Columbus, Ohio, and the **Stacey Engineering Company,** which operates the P. H. & F. M. Roots Company and the Connersville Blower Company, Connersville, Ind., have merged forming the **International Stacey Corporation,** with general offices in Columbus, Ohio. **Col. Carmi A. Thompson,** president of the Stacey Engineering Company, is Chairman of the board of directors of the new company, and **Harry M. Runkle,** president of International Derrick & Equipment, is president and general manager.

Personal

W. L. Lewis, vice-president in charge of finance of the Chicago Pneumatic Tool Company, New York City, has been appointed executive vice-president with headquarters as before at New York.

J. H. Morris, assistant secretary and assistant treasurer of the **Inland Steel Company,** has been promoted to secretary. **W. D. Truesdale,** secretary and treasurer, will continue as treasurer.

Alvah H. Warren, Jr., assistant manager of sales of the **Illinois Steel Company,** Chicago, with headquarters at St. Paul, Minn., has been promoted to manager of sales to succeed **W. J. Totten,** who retired on April 21.

W. R. Meadows, Inc., Elgin, Ill., has placed **E. H. Batchelder, Jr.,** 608 South Dearborn street, Chicago, in charge of the railroad sales of asphalt plank and expansion joints. Mr. Batchelder is also president of the **Federal Equipment Corporation,** of that address.

R. F. Mehl, superintendent of the division of physical metallurgy of the Naval Research Laboratory has been appointed assistant director of research of the **American Rolling Mill Company,** Middletown, Ohio. Mr. Mehl will assume his new duties on September 1.

J. K. Aimer has been appointed assistant general manager of sales of the **Reading Iron Company,** with office at 230 Park avenue, New York. **W. S. Shiffer** has been appointed assistant to general manager of sales, and **R. I. Fretz** has been transferred from the Reading district and is in charge as district sales representative of the Pittsburgh district in place of **Wyman Howells,** who now directs the activities of the Reading district; **Harry L. Bialock** is associated with the St. Louis district under the direction of **J. L. Jacobson,** district sales representative; **L. C. Hartzell,** under the direction of **R. W. Thompson,** Reading, Pa., is engaged in the promotion of the nipple business; **George D. Smith,** has been appointed railroad salesman under the direction of Mr. Aimer and **E. S. Moorehead** has been assigned to the Pittsburgh district under the direction of Mr. Fretz.

William Thompson, assistant to the president of the **American Steel & Wire Company,** Cleveland, Ohio, retired on May 1. **George F. Rummel,** for the past two years assigned to special work and during the previous 26 years assistant general manager of sales, also retired on May 1.

Hugh E. Hale, vice-chairman of the Eastern Group, Presidents' Conference Committee on Federal Valuation of Railroads, with headquarters at New York, has established offices under the name of **H. E. Hale & Company,** 32 Nassau street, New York, for the general practice of engineering, specializing in railroad and utility valuations, financial analyses and reports. Mr. Hale was born on April 8, 1874, at Minomen, Minn., and was graduated from Lehigh University as a civil engineer in 1897. He previously served in 1896 as an assistant engineer on the Pennsylvania at Philadelphia, Pa. From 1898 to 1899, he was assistant engineer at Altoona, then being appointed assistant supervisor of signals at Jersey City, N. J., and from 1901 to 1902 he was supervisor of signals

Hugh E. Hale

at Camden on the same road. From 1902 to 1903 he was division engineer on the Baltimore & Ohio at Philadelphia, being promoted to superintendent at Butler, Pa., on the latter date. In 1905 he was made engineer maintenance of way at Baltimore, Md. In 1908 Mr. Hale entered the service of the Missouri Pacific as engineer of design at St. Louis, Mo., and in 1910 was appointed principal assistant engineer of the same road at that place. From 1911 to 1914 he served as engineer maintenance of way on the same road at Little Rock, Ark. In March, 1914, he was appointed engineer, Eastern Group, Presidents' Conference Committee on Federal Valuation of Railroads, with headquarters at New York, and since 1926 has served as vice-chairman of the same organization.

R. H. Bacon, advertising manager of **Fairbanks, Morse & Company,** with headquarters at Chicago, has been promoted to manager of the pump sales division, with the same headquarters, succeeding **M. B. MacNeille,** who has resigned to join the sales organization of the **Dayton-Dowd Company,** Quincy, Ill. Mr. MacNeille will act as western sales manager, with headquarters at San Francisco, Cal.

R. H. Bacon

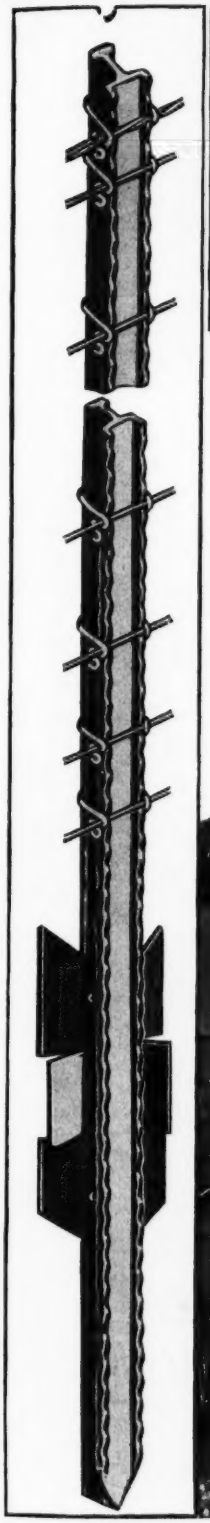
Mr. Bacon graduated from the University of Illinois in 1916, after which he was employed as assistant engineering editor of Electrical World and assistant electrical engineer for the Copper Range Mining Company. From 1922 to 1925 he was associate editor of Power Plant Engineering, resigning in the latter year to take charge of publicity for the Diesel engine division of Fairbanks, Morse & Co. Shortly thereafter he was placed in charge of general publicity, and since 1929 has been manager of the advertising and publicity department.

Trade Publications

The Loadmaster—The Bucyrus-Erie Co., South Milwaukee, Wis., is distributing an eight-page pamphlet illustrating and describing the Loadmaster, as well as some of its uses.

Armco Perforated Pipe—The Armco Culvert Manufacturers Association, Middletown, Ohio, has recently issued Catalogue No. 4 containing much useful information on the various applications of Armco perforated pipe. The booklet contains 24 pages and is attractively illustrated.

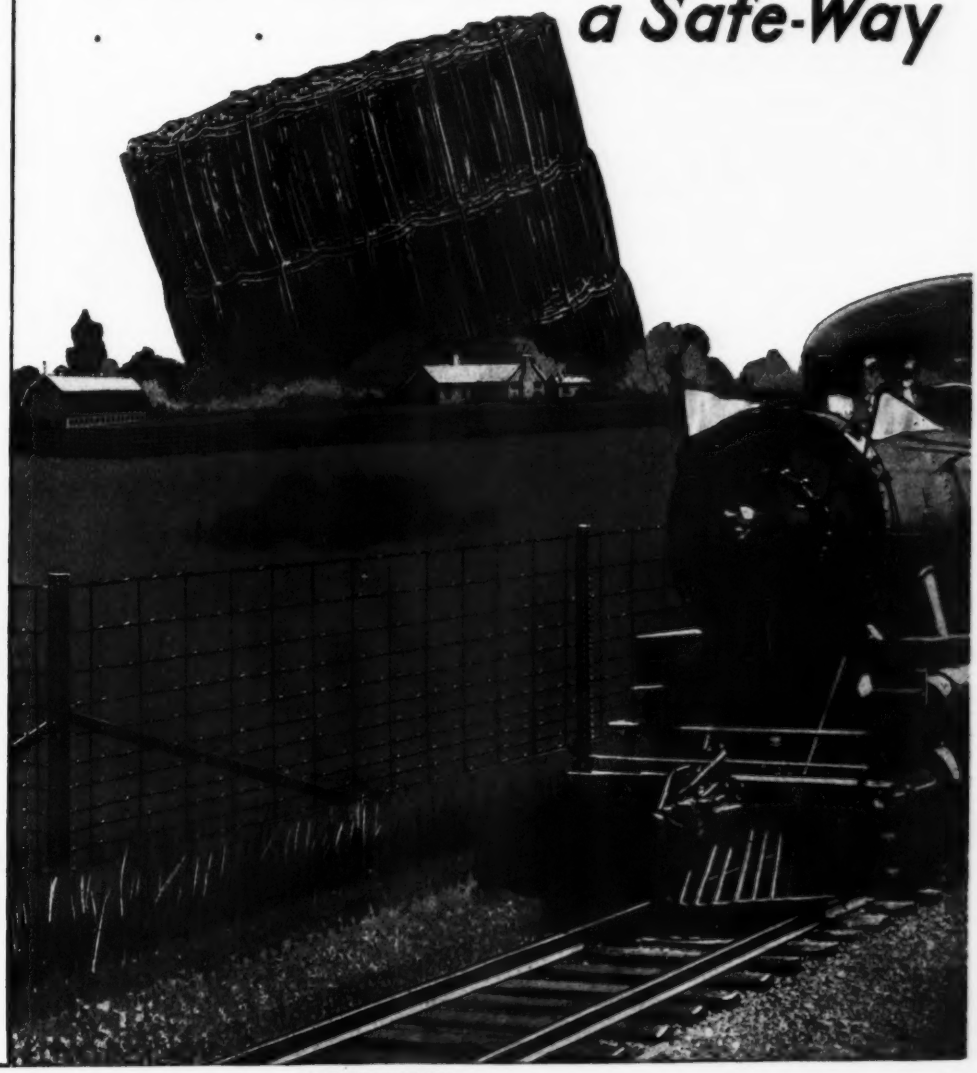
Hot Shot Switch Heater—A four-page folder describing the Hot Shot Switch Heater, which utilizes electrically-heated air to melt snow and ice, has been issued by the Louisville Frog, Switch & Signal Co., Louisville, Ky.



AMERICAN Fence and BANNER STEEL POSTS

IT is cheaper to put up a good fence than to pay stock claims. Likewise it is economy to buy adequate protection—proved protection—such as that offered by American Railroad Fence and Banner Steel Line Posts—the post of railroad rail construction. These products including National Expanding Anchor End and Corner Posts meet every specification recommended by the American Railway Engineering Association.

Make Your Right-of-Way- - a Safe-Way



1831

1931

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago SUBSIDIARY OF UNITED STATES STEEL CORPORATION And All Principal Cities

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco *Export Distributors:* United States Steel Products Company, New York

ORDER YOUR COPY NOW!

Owing to the many requests for reprints within one cover of the series of articles on "The Operation and Maintenance of Track Motor Cars," by C. R. Knowles which have been appearing serially in Railway Engineering and Maintenance since January, 1930 and conclude with the May issue, we are reprinting these articles in a booklet of some 66 pages, bound in an attractive cover.

This series of articles, 15 in number, contains a vast fund of practical information on the design, use and care of motor cars that has long been sought by maintenance men.

The subjects covered in detail in this series are as follows:

1—The Place of the Track Motor Car in Maintenance Work.
2—The Classification of Motor Cars As to Type and Use.
3—The Motor Car Engine.
4—The Motor Car Chassis.
5—The Lubrication of a Motor Car.
6—The Ignition System.
7—The Care of a Motor Car.
8—How to Secure Efficient Operation.
9—Operating Motor Cars Safely (Three articles)
10—How to Keep the Car Running (Two articles)
11—Organizing for The Repair of Cars
12—The Economies Possible With Motor Cars

These booklets will be available at 50 cents per copy.

SEND IN YOUR ORDERS NOW. COPIES WILL BE READY ABOUT JUNE 15.

Railway Engineering and Maintenance

105 West Adams Street **CHICAGO, ILLINOIS**

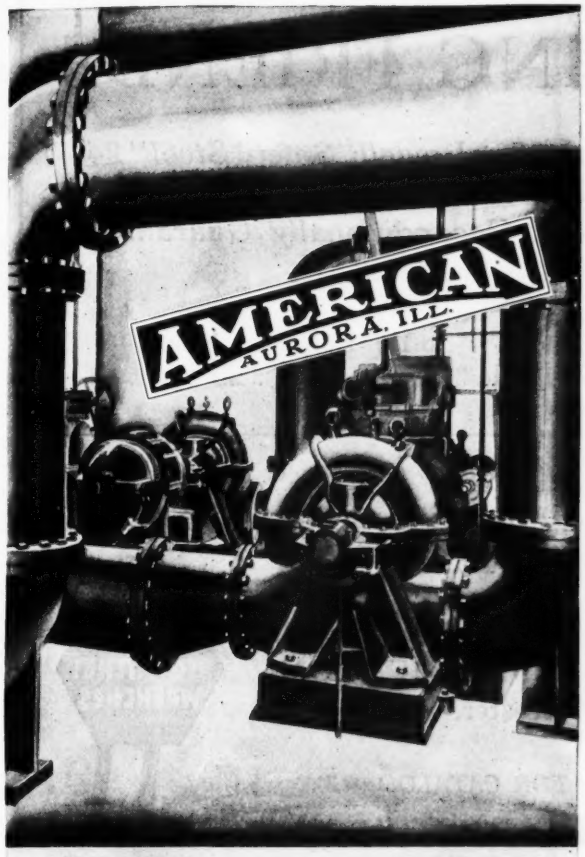
RAILWAY ENGINEERING AND MAINTENANCE,
105 West Adams St., Chicago, Ill.

Please enter my order for.....copies of "The Operation and Maintenance of Track Motor Cars" by C. R. Knowles, at 50 cents per copy for which find enclosed $.....

Name..... Address.....

City..... State.....

Position..... Company.....



"AMERICAN" PUMPS at NEW ROCHELLE

THREE fifteen-inch large capacity "American" Centrifugal Pumps are in service in the Sewage Pumping Station in New Rochelle. The city depends upon the uninterrupted disposition of its sewage and wastes, to maintain its inhabitants' good health.

Ample pure water — sufficient fire protection — and efficient sewage disposal is a matter of sufficient dependable pumping capacity.

Over a period of a great many years, "American" Centrifugal Pumps, Sewage Pumps, Deep Well Turbines, and Deep Well Plunger Pumps have come to be standard equipment for the day after day reliable service required in railway pumping.

THE AMERICAN WELL WORKS
General Offices AURORA, ILLINOIS *and Factory*

BRANCH OFFICES

CHICAGO ILL., 20 N. WACKER DRIVE — KANSAS CITY, MO., COMMERCE BUILDING
LOS ANGELES, CALIF., 416 E. THIRD ST. — NEW YORK, N. Y., 165 BROADWAY

DISTRICT SALES AGENCIES

ATLANTA, GA.	DETROIT, MICH.	OMAHA, NEB.	SEATTLE, WASH.
BIRMINGHAM, ALA.	EL PASO, TEXAS	PHILADELPHIA, PA.	ST. LOUIS, MO.
CAMBRIDGE, MASS.	HOUSTON, TEX.	PORTLAND, OREGON	ST. PAUL, MINN.
CHARLOTTE, N. C.	JOPLIN, MO.	PORTALES, N. MEX.	TULSA, OKLA.
DALLAS, TEXAS	MILWAUKEE, WIS.	SALT LAKE CITY, UTAH	VANCOUVER, B. C., CANADA
DENVER, COLO.	NEW ORLEANS, LA.	SAN FRANCISCO, CALIF.	

Plain bolted frog which had been worn out; and quickly reclaimed by welding with TIMANG.

Same frog after being welded with TIMANG Manganese Welding Rod in the track.

WELD MANGANESE TRACKWORK WITH

TISCO TIMANG (AIR TOUGHENING) Welding Rod

MANGANESE track welds made with TIMANG (air toughening) Welding Rod have practically the same hardness — the same resistance to wear — as the parent metal. Moreover, TIMANG welds are ductile, and will not crack in service.

If you are anxious to lower track maintenance, investigate TIMANG today. Communicate with the nearest TISCO office, or write to High Bridge for TIMANG bulletins.

"TIMANG" Trade Mark is registered in United States and foreign countries. "TIMANG" Steel is protected by U. S. Patent 1,732,202 and foreign patents. Other patents pending.

Taylor-Wharton Iron and Steel Co.
HIGH BRIDGE, NEW JERSEY

SALES OFFICES: Chicago Houston Montreal New York Philadelphia Boston San Francisco Scranton Tampa Los Angeles

WE ARE MAKING FRIENDS

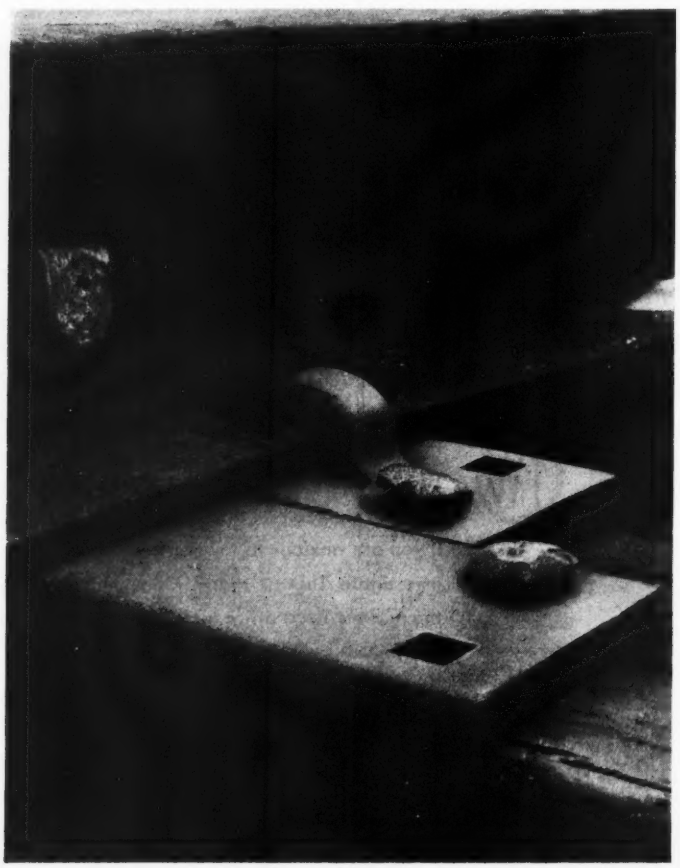
With This New Lowell "Safety Steel" 24" Reversible Ratchet Socket Wrench. A Tested and Unconditionally Guaranteed Handle.

Capacity 5/8" to 1¼" Bolt Dia. Nuts
(1¼" to 2" Across the Flats.)

Requisition For One Today!

Lowell Wrench Co.
Worcester, Mass.

SEND FOR CATALOG "G"



TWIN Frog Plates

fit any angle of the frog

Bethlehem Twin Frog Plates are made of rolled steel and have a forged steel hook that fits over the base flange of the frog, holding it down on the plate and in position. The forged hook is larger and heavier than a track spike and has greater strength and holding power. The bases of the frog plates are flat, providing a uniform bearing on the tie and maximum protection against mechanical injury or wear. Twin Frog Plates are furnished in standard lengths of 23 in., 26 in., and 28 in. They fit any size of frog, and are interchangeable.

BETHLEHEM STEEL COMPANY
General Offices: BETHLEHEM, PA.

District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago, St. Louis.

Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Los Angeles, Portland, Seattle, Honolulu.

Export Distributor: Bethlehem Steel Export Corporation, 25 Broadway, New York City.

BETHLEHEM

BY THIS SIGN YOU WILL KNOW THEM

JACKSON LUMBER COMPANY
POLES
DIXIE
PILING
LOCKHART, ALABAMA

TRADE MARK

SYMBOL OF A COMPLETELY OWNED OPERATION FROM TREE TO LOADED CAR

This Warranty Mark signifies Dense Long Leaf Yellow Pine, correctly seasoned and uniformly graded, and it is branded on every piece of Jackson stock.

Selling Agents

ROBERT W. FORBES
Room 2845
Grand Central Terminal
New York City

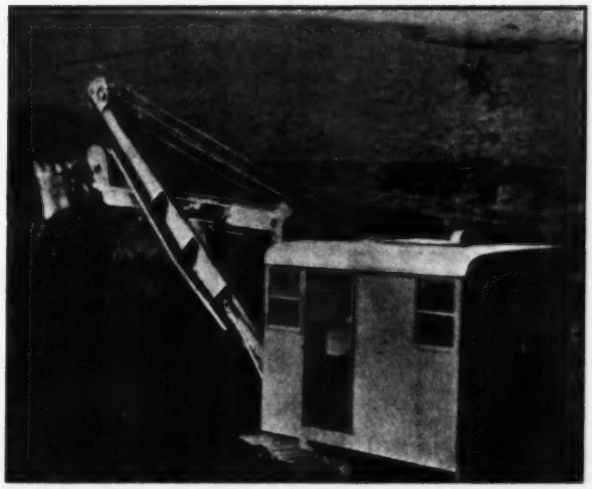
F. B. MERRITT
Room 1560
First National Bank Bldg.
Detroit, Mich.

JACKSON LUMBER CO.

Manufacturers

Lockhart, Alabama

A CROSSETT WATZEK GATES INDUSTRY



BUCKEYE 3/8-YARD SHOVEL-CRANE

Efficient Assembly . . . Rugged Strength Assure Steady, Profitable Performance

Extremely wide range of usefulness is the chief characteristic of this little revolving, convertible shovel, crane, clamshell and dragline. Equally important, is its ability to deliver any or all of its services continuously.

Skillful design and assembly make 3/8-yard Buckeye the master material handler of its class and capacity. Simplicity distinguishes its mechanism, yet all parts and units are co-ordinated in action, and controls conveniently grouped, to provide effective, easy one-man operation.

Rotating and traveling bases are one-piece electric steel castings. 54 h. p. industrial type motor, electrically started, forms a complete assembly with the radiator, clutch and two-speed transmission. 19-foot boom is rigidly reinforced to insure permanent alignment. 12-foot dipper stick travels inside of boom. One-piece manganese steel dipper has a capacity of .444 cubic yards, struck measure; its teeth are reversible and its digging angles variable.

***Alligator (Crawler) Traction* fit it for duty independent of rail. *Flanged Wheels* enable it to operate from main track or from rail laid on flat cars.**

May we send you complete specifications?

The Buckeye Traction Ditcher Co.

FINDLAY, OHIO

There's a Buckeye Sales and Service Office Near You

for over thirty years **Buckeye**

Business Paper Advertising ...Sign of an Efficient Manufacturer

WHEN you see a manufacturer's advertising in the pages of your business paper, you may know that *that* manufacturer is not only efficient in production, but that he also knows how to *distribute* effectively and economically.

And that is important to you as a purchaser of manufactured articles. For the cost of distribution enters into the cost of everything you buy. Efficiently distributed goods cost less, quality for quality, than goods distributed through haphazard methods.

Manufacturers who advertise in business papers use the shortest, directest, most economical way to reach you with a selling message. They are buying concentrated circulation *without waste.* They are applying advertising dollars wisely where those dollars will reduce other selling costs.

Through their selection of efficient means to advertise, they are giving proof that the products they offer to you bear the minimum cost of distribution—that those products, quality for quality, are lower in cost than products distributed either laboriously *without* advertising or carelessly with *wasteful* advertising.

THIS SYMBOL *identifies an ABP paper . . . It stands for honest, known, paid circulation; straightforward business methods, and editorial standards that insure reader interest . . . These are the factors that make a valuable advertising medium.*

RAILWAY ENGINEERING AND MAINTENANCE
IS A MEMBER OF

THE ASSOCIATED BUSINESS PAPERS, INC.
TWO-NINETY-FIVE MADISON AVENUE - NEW YORK CITY

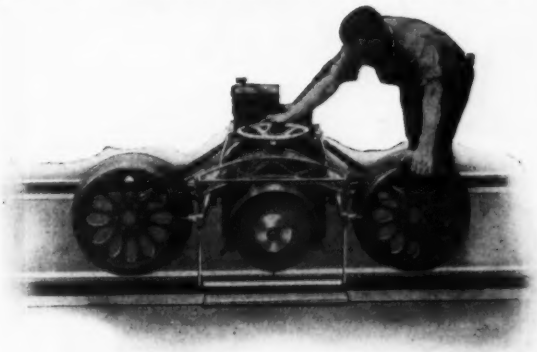
Save the Rail -- Save the Structure

Cupped or battered rail joints and corrugations spread damage progressively. Lack of rail maintenance soon damages the track structure. Arc welding and grinding repair the damage before the job becomes expensive. Here are rail grinders that do a machine-tool job in a hurry with economy.

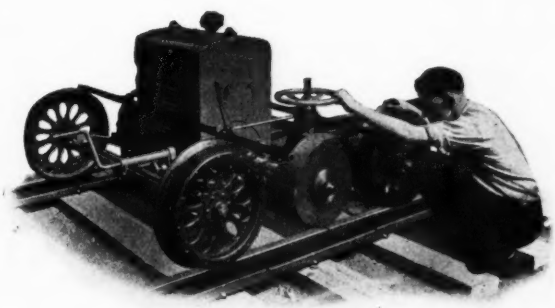
Model P-3 grinds one rail joint at a time, pivots to grind the opposite rail. Electric motor powered.

Model P-2 has two grinding heads working independently on opposite rails. Electric motor powered.

Model P-4 is gasoline engine powered.



Model P-3



Model P-4

Description and quotation on request.

Railway Trackwork Co.

3132-48 East Thompson Street
Philadelphia

5340

On Pneumatic Tube Lines

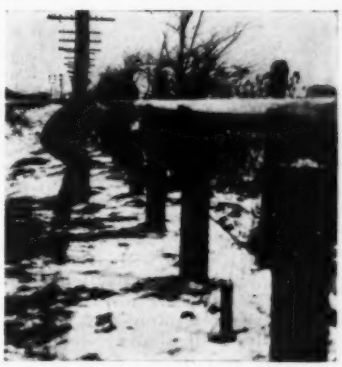
The Master Coat

Illustrations show application of NO-OX-ID Filler, Red, over gray NO-OX-ID-IZED Wrapper to give reliable long-lived protection to this pneumatic tube line. The temperature was 20° F. yet the NO-OX-ID was applied easily. Thousands of miles of buried and exposed pipe lines are protected with the Master Coat consisting of a coat of NO-OX-ID on the metal, followed by the wrapper and then a finishing Service Coat. This combination marks the greatest advance made to date in the fight against rusting, pitting, corrosion—and in the case of buried lines, against soil stress. Investigate the Master Coat. Recommendations and estimates supplied gladly.

DEARBORN CHEMICAL COMPANY

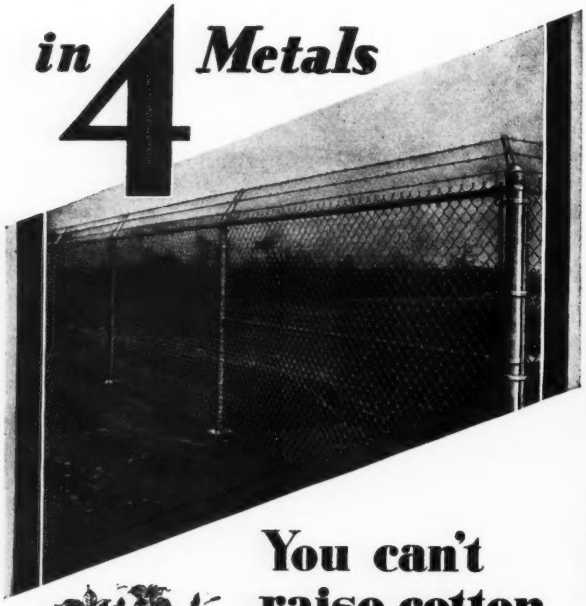
205 East 42nd Street, New York
310 S. Michigan Avenue, Chicago
Canadian Factory and Offices:
2454-2464 Dundas St., W., Toronto

NO-OX-ID
IRON-OX-RUST
The Original Rust Preventive

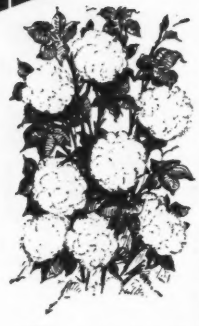


PAGE FENCE

in 4 Metals



You can't raise cotton in MINNESOTA



Atmospheric conditions are against the raising of this splendid product so far north.

AND ATMOSPHERIC CONDITIONS PLAY JUST AS IMPORTANT A PART IN THE SELECTION OF PROPER FENCING WHEN COST PER YEAR OF SERVICE IS CONSIDERED.

The corrosive elements in the atmosphere vary in different localities. No one fence will successfully withstand all these destructive influences. That's why PAGE Fence is available in these four fine metals—so that selection can be made according to conditions under which it is to serve:

1. PAGE ALCOA ALUMINUM
2. PAGE ARMCO INGOT IRON
3. PAGE COPPER-BEARING STEEL
4. PAGE ORNAMENTAL WROUGHT IRON

Call in a PAGE Fence expert. He will tell you which PAGE Fence will give the longest service at the least upkeep in your particular locality.

76 Service Plants erect PAGE Fence everywhere. Write for name and address of plant nearest you. They will gladly consult with you and offer suggestions from plans to erection. Also, send for new illustrated booklet—Border Patrol—which contains complete information and shows various styles. No obligation. Address Page Fence Association, 520 N. Michigan Ave., Dept. D70, Chicago, Ill.

America's first wire fence since 1883

PAGE

nation-wide service through 76 service plants

FENCE

Fence of Armco Ingot Iron fabric is exclusive with Page

Page Fence is a Product of The Page Steel & Wire Company, an Associate Company of American Chain Co., Inc.

CHAIN LINK OR ORNAMENTAL WROUGHT IRON

PORTER HKP

PORTABLE HAND OPERATED

CUTTING TOOLS

Along the sides of this advertisement we show the cutting jaws of several Porter Tools and below, close up views of these tools in use — Shear Cutter on wire rope, Angular Cutter on tie wire, Nut Splitter ready to remove nut, End and Angular Bolt Clippers and the Chain Cutter. These represent popular models in a line of 60 powerful portable hand operated cutting tools—all of them built on the lever and toggle joint principle which multiplies applied power about 70 times. The largest Bolt Clipper cuts annealed bolts in the thread up to 3-4 inch. The Shear Cutter has a maximum capacity of 5-8 inch soft wire rope or 1 1-2 x 9-32 inch soft bars.

Porter Tools are quick — they save time and labor in production, maintenance, dismantling and repairs. They are used in practically every industry.

Write for descriptive literature — ask your jobber.

H. K. PORTER INC.

44 Ashland Street

EVERETT, MASS.

THEY SHALL NOT PASS

THE DURABLE MODEL D

(Patented Aug. 3rd, 1920, Pat. No. 1348223, Other Patents Pending)

A Bumping Post that can be used with equal success in freight or in passenger service.

There are track ends on every railroad where an overrun car spells disaster. But no matter where it happens, a car off the tracks is a nuisance—and it's expensive too.

With a DURABLE saying "They Shall Not Pass" at every track end, those annoying and costly overruns are stopped—permanently.

Tests have proved its dependability so conclusively that the DURABLE is now standard equipment on many railroads throughout the United States. For SAFE track ends, specify the DURABLE Bumping Post.

Mechanical Manufacturing Company

Union Stock Yards, Chicago, Ill.

(Also Manufacturers of the Ellis Post)

Creo-pine

CREOSOTED SOUTHERN PINE

The name Creo-pine on creosoted southern pine is more than a trade mark. It is a pledge of honest, accurate manufacture and rigid inspection from standing tree to finished product. Back of it are 23 years of wood preserving experience.

Always Ready to Fill Rush Orders

for finest grade Cross Ties

Creo-Pine products include:

Poles
Piling
Conduit
Cross Ties
Cross Arms
Floor Blocks
Sub-Flooring
Bridge Timbers
Structural Timbers

UNUSUAL treating advantages, high and dry storage yards and ample railroad facilities assist us in making prompt shipment of highest grade creosoted cross ties—pine from Georgia and Alabama, red oak from Tennessee. We can supply large or small quantities at a minimum production cost from our two plants, at East Point, Georgia, and Chattanooga, Tennessee. All ties are creosoted by the vacuum-pressure method, assuring deep and uniform penetration, long life and lowest cost per year of service. Let us know your requirements.

SOUTHERN WOOD PRESERVING CO.
ATLANTA, GA.

Treating Plants EAST POINT, GA., *and* CHATTANOOGA, TENN.

Sales Offices:

NEW YORK PHILADELPHIA PITTSBURGH DETROIT
CHATTANOOGA CHARLOTTE, N.C. TOLEDO

No Need to Suffer from Lice

WHEN you fumigate a camp car with Railroad Calcyanide you destroy all "bugs" in the car, in mattresses, pillows, blankets, quilts, etc.

If clothing which the men are wearing is infested by lice, just throw it into the car before you apply this remarkable fumigant. After the fumigation you will not be able to find a single live louse.

The gas from Railroad Calcyanide is equally efficient against bedbugs, fleas, cockroaches, moths, rats, mice and other pests.

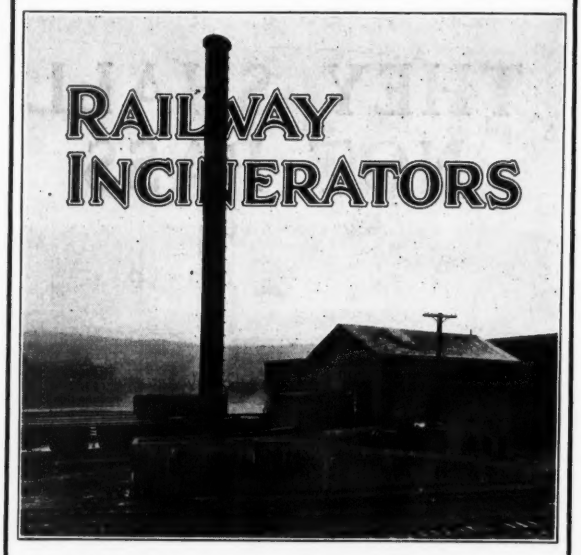
Order a 2-lb. or 3-lb. can of Railroad Calcyanide, with the understanding that our invoice will be cheerfully cancelled if your experience does not conclusively prove that THIS IS THE BEST PRODUCT YOU HAVE EVER USED FOR THE DESTRUCTION OF INSECTS AND RODENTS.

Simple directions for application are contained in our booklet on "Railroad Calcyanide for Railroad Facilities"—sent free for the asking.

CALCYANIDE COMPANY

60 E. 42nd St. MAIN OFFICE NEW YORK CITY

Distributors: CHICAGO, Smithereen Co., 7417 Stony Island Ave.; SAN FRANCISCO, John F. Leinen Sanitation Co., 1337 Mission St.; HARTFORD, Birchard System, Inc., 312 Church St.; VANCOUVER, Geo. C. Elliott, Ltd., 325 Howe St.



A CLEAN-UP JOB FOR THE P. R. R.

Out at the 20th Street Produce Yards, Pittsburgh, Pa., the above "Pittsburgh-Des Moines" Incinerator is daily destroying all rotten vegetable produce, and food wastes from dining cars for The Pennsylvania Railroad Company. This scientific destructor plant has a capacity of 50 tons of garbage and rubbish every 24 hours.

The P. R. R. Incinerator Plant was installed in 1929, and today is rendering the satisfied officials of the Pennsy's new enlarged freight produce terminal and yards an economical, reliable and steady performance—day in and day out.

Write today for the 20-page booklet "Railway Water Service" describing PDM Elevated Tanks, Standpipes, and Water Treating Plants for Railways.

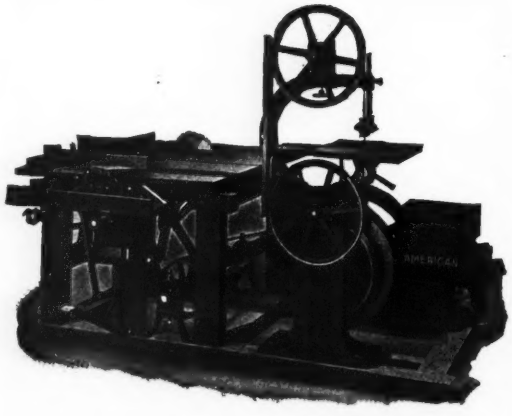
PITTSBURGH-DES MOINES STEEL COMPANY

3422 Neville Island, Pittsburgh, Pa.

923 Tuttle St., Des Moines Room 920, 270 Broadway, New York

Chicago Atlanta Dallas San Francisco Seattle

COST CUTTERS



Portable Woodworking Machinery
Variety Woodworkers,
Rip and Cut-off Saws, Saw Mills,
Timber Resaws, Planers

Ask for Bulletin No. 82

American Saw Mill Machinery Co.

164 Main Street Hackettstown, N. J.

"A Single Breaker May Recede— but The Tide Is Coming In!"

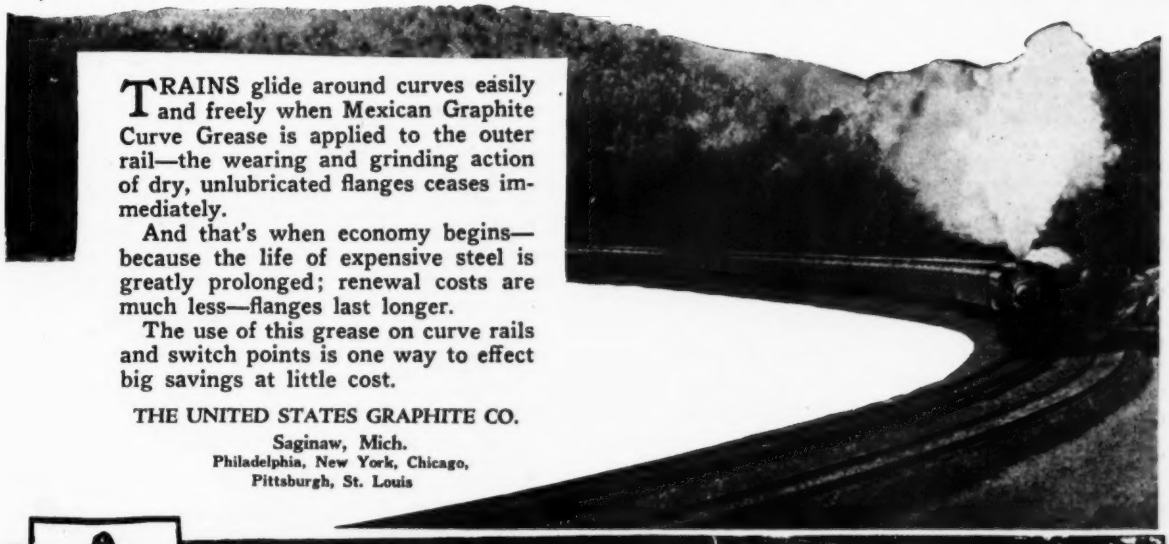
Business is on the turn. The demand for competent men will soon be on the increase. When your turn comes, here's the means to find the man you want. THE NATIONAL ENGINEERING SOCIETIES and AMERICAN TRADE ASSOCIATION EXECUTIVES have rosters of surprisingly well-qualified technicians and business executives. Due to the present emergency men of splendid experience have been made available.

When you are in need of industrial and technical executives, professional engineers, or technicians—communicate with:—Engineering Societies Employment Service: New York Office—Walter V. Brown, Manager, 31 West 39th Street; Chicago Office:—A. Krauser, Manager, 205 West Wacker Drive; San Francisco Office—Newton D. Cook, Manager, Room 715, 57 Post Street.

Should your requirements be for business or trade executives, write:—American Trade Association Executives, 45 East 17th Street, New York, N. Y.

This service is the contribution of these professional organizations to industry.

REDUCE RAIL WEAR ON CURVES
With
MEXICAN GRAPHITE CURVE GREASE



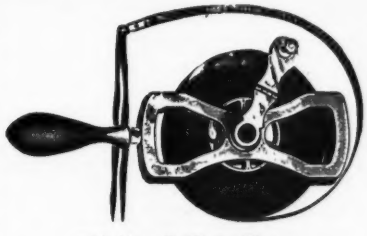
TRAINS glide around curves easily and freely when Mexican Graphite Curve Grease is applied to the outer rail—the wearing and grinding action of dry, unlubricated flanges ceases immediately.

And that's when economy begins—because the life of expensive steel is greatly prolonged; renewal costs are much less—flanges last longer.

The use of this grease on curve rails and switch points is one way to effect big savings at little cost.

THE UNITED STATES GRAPHITE CO.
Saginaw, Mich.
Philadelphia, New York, Chicago,
Pittsburgh, St. Louis

Mexican Graphite Curve Grease USG
SAVES RAILS – REDUCES FLANGE WEAR



"Michigan" Chain Tapes

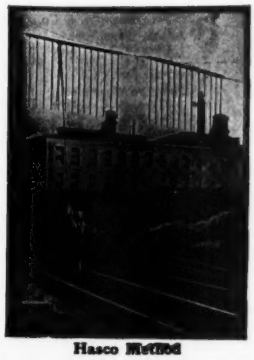
Sturdy tapes 5/16" wide. Built for hard use. Regularly carry blank space but furnished measuring from end of ring if specified. Half-gauge marks when requested.

FOR ACCURACY and SERVICE
LUFKIN
TAPES, RULES and TOOLS

With them correct measurements are assured—whether in shop, engineering, or construction work.

Send for Catalog.

THE LUFKIN RULE CO. SAGINAW, MICH.
New York · Windsor, Ont.



Hasco Method

SAFETY AND EFFICIENCY
with HASCO HANGERS and TELL-TALES and SIDE CLEARANCE WARNINGS

Last I. C. C. Reports show 43 Killed and 400 Injured, striking fixed structures.

THIS CAN BE AVOIDED

HASCO Hangers and Tell-Tales are a big improvement over the old type of bridge and tunnel warning devices. They provide 100% protection and eliminate practically all maintenance costs.

HASCO Side Clearance Warnings caution employees riding on the side of a car that they are approaching a building, platform or some other side obstruction which may cause injury or death.

STANDARD EQUIPMENT ON LEADING ROADS

Write us for complete information.

The Hastings Signal and Equipment Co.
53 State Street, Boston, Mass.

Side Clearance Warnings

CLASSIFIED INDEX TO ADVERTISERS

Acetylene
Oxweld Railway Service Company

Adzing Machine
Nordberg Mfg. Co.

Air Compressors
Baldwin-Southwark Corp.
Southwark Foundry & Machine Co., Div.
Fairbanks, Morse & Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Air Hoists
Ingersoll-Rand Co.
Sullivan Machinery Co.

Air Lift Pumping Machinery
Ingersoll-Rand Co.
Sullivan Machinery Co.

Anti-Creepers, Rail
American Fork & Hoe Co.
Bethlehem Steel Co.
Lundie Engineering Co.
P. & M. Co.
Verona Tool Works
Woodings Forge & Tool Co.

Backfillers
Buckeye Traction Ditcher Co.

Backfiller Cranes
Buckeye Traction Ditcher Co.

Ballast Cleaners
Industrial Brownhoist Corp.

Ballast Screens
Maintenance Equipment Co.

Ballast Spreaders
Bucyrus-Erie Co.
Western Wheeled Scraper Co.

Ballaster, Power
Maintenance Equipment Co.

Bank Builders
Bucyrus-Erie Co.

Bank Slopers
Bucyrus-Erie Co.

Band Saws
American Saw Mill Machinery Co.

Bars
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Company

Bearings, Axle
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Bearings, Roller
Timken Roller Bearing Co.

Bearings, Tapered Roller; Thrust and Journal Box
Timken Roller Bearing Co.

Benders, Rail
See Rail Benders

Blocks, Creosoted
So. Wood Preserving Co.

Bolts
Bethlehem Steel Co.
Illinois Steel Co.
Louisville Frog, Switch & Signal Co.
Oliver Iron & Steel Corp.

Bonding Outfits, Rail
Ingersoll-Rand Co.
Syntron Co.

Braces, Track
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Bridge Floors
Armco Culvert Mfrs. Assn.
Illinois Steel Co.

Bridge Warnings
Hastings Signal & Equipment Co.

Buckets
Bucyrus-Erie Co.
Industrial Brownhoist Corp.

Buckets, Clam Shell
Cullen-Friestedt Co.
Industrial Brownhoist Corp.

Building Beams, Concrete
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Buildings, Steel Frame
Butler Mfg. Co.

Bumping Posts
Louisville Frog, Switch & Signal Co.
Mechanical Mfg. Co.

Car Replacers
Louisville Frog, Switch & Signal Co.

Car Stop, Friction
Maintenance Equipment Co.

Carbic
Oxweld Railroad Service Co.

Carbide
Oxweld Railroad Service Co.

Cars, Hand
Fairbanks, Morse & Co.
Fairmont Ry. Motors, Inc.

Cars, Industrial
Bethlehem Steel Co.
Koppel Industrial Car & Equipment Co.
Magor Car Corp.
Western Wheeled Scraper Co.

Cars, Inspection
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Cars, Motor
Fairbanks, Morse & Co.
Fairmont Ry. Supply Co.

Cars, Section
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Cars, Spreader
Bucyrus-Erie Co.
Western Wheeled Scraper Co.

Cars, Velocipede
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Castings
Bethlehem Steel Co.
Timken Roller Bearing Co.
Wharton, Jr. & Co., Inc., Wm.

Catchbasins
Armco Culvert Mfrs. Assn.

Cattle Guards
Fairbanks, Morse & Co.

Cattle Passes
Massey Concrete Products Corp.

Cement Paint
Medusa Cement Co.

Cement, Portland
Medusa Cement Co.

Cement Roofing Tile
Federal-American Cement Tile Co.

Chemical Weed Killer
Chipman Chemical Engineering Co., Inc.

Clay Diggers
Buckeye Traction Ditcher Co.

Clips, Adjustable
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Coal Handling Machinery
Buckeye Traction Ditcher Co.
Industrial Brownhoist Corp.
Northwest Engineering Co.

Coaling Stations
Fairbanks, Morse & Co.

Compressors
Ingersoll-Rand Co.
Sullivan Machinery Co.

Compromise Joints
See Joints, Compromise

Concrete Roofing Tile
Federal-American Cement Tile Co.

Concrete Units, Miscellaneous
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Condensers
Ingersoll-Rand Co.

Corrosion Preventive
Dearborn Chemical Co.

Corrugated Iron
Armco Culvert Mfrs. Assn.

Cranes
Buckeye Traction Ditcher Co.
Bucyrus-Erie Co.
Cullen-Friestedt Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Northwest Engineering Co.
Orton Crane & Shovel Co.

Cribbing, Concrete
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Crossings, Rail
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Culvert Pipe
Armco Culvert Mfrs. Assn.
Gohl Culvert Mfrs., Inc.
Massey Concrete Products Corp.

Culverts, Corrugated Metal
Armco Culvert Mfrs. Assn.
Gohl Culvert Mfrs., Inc.

Culverts, Paved Invert
Armco Culvert Mfrs. Assn.

Culverts, Treated
So. Wood Preserving Co.

Curbing
Massey Concrete Products Corp.

Derails
Q. & C. Co.
Wharton, Jr. & Co., Wm.

Derailing Switches
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Derrick Cars
Cullen-Friestedt Co.
Maintenance Equipment Co.

Diesel Engines
Fairbanks, Morse & Co.
Ingersoll-Rand Co.

Diesel Electric Power Plants
Fairbanks, Morse & Co.
Ingersoll-Rand Co.

Dieing Machines
Fairmont Railway Motors, Inc.

Disinfectants
Chipman Chemical Engineering Co., Inc.

Ditchers, Curb
American Hoist & Derrick Co.
Buckeye Traction Ditcher Co.
Industrial Brownhoist Corp.

Ditchers, Drainage
American Hoist & Derrick Co.
Buckeye Traction Ditcher Co.
Bucyrus-Erie Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Northwest Engineering Co.

Ditchers, Open
American Hoist & Derrick Co.
Buckeye Traction Ditcher Co.
Industrial Brownhoist Corp.

Ditchers, Tile
American Hoist & Derrick Co.
Buckeye Traction Ditcher Co.
Bucyrus-Erie Co.
Industrial Brownhoist Corp.

Draglines
Buckeye Traction Ditcher Co.
Industrial Brownhoist Corp.
Northwest Engineering Co.

Drainage Gates
Armco Culvert Mfrs. Assn.

Drains, Perforated
Armco Culvert Mfrs. Assn.

Drills, Portable Electric
Syntron Co.

Drills, Pneumatic
Ingersoll-Rand Co.

Drills, Rock
Ingersoll-Rand Co.
Sullivan Machinery Co.
Verona Tool Works

Drill Steel, Rock
Bethlehem Steel Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drills, Track
Louisville Frog, Switch & Signal Co.
Ingersoll-Rand Co.
Syntron Co.

Dump Cars
Koppel Industrial Car & Equipment Co.
Magor Car Corp.
Western Wheeled Scraper Co.

Electric Light and Power Plants
Fairbanks, Morse & Co.

Electric Power Units
Electric Tamper & Equipment Co.
Syntron Co.

Electric Snow Melters
Louisville Frog, Switch & Signal Co.
Lundie Engineering Corp.
Q. & C. Co.
Ruby Railway Equipment Co.

Electric Welding
Electric Railweld Sales Corp.
Syntron Co.

Engines, Gasoline
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Engines, Motor Car
Fairbanks, Morse & Co.
Fairmont Railway Motors, Co.

Engines, Oil
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Ingersoll-Rand Co.

Excavators
Buckeye Traction Ditcher Co.
Bucyrus-Erie Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Northwest Engineering Co.

Fences
American Steel & Wire Co.
Anchor Post Fence Co.
Bethlehem Steel Co.
Page Fence Association.
Q. & C. Co.

Fence Fabric
American Steel & Wire Co.
Anchor Post Fence Co.
Bethlehem Steel Co.
Page Fence Association.

Fence Posts
American Steel & Wire Co.
Massey Concrete Products Corp.
Q. & C. Co.

Fence Posts, Treated
So. Wood Preserving Co.

Fibre angle pieces, bushings, plates, end posts, etc.
Q. & C. Co.

Fibre Insulations
Q. & C. Co.

Flange Lubricators
Maintenance Equipment Co.

Flangers, Snow
Q. & C. Co.

Flangeway Guard
Bethlehem Steel Co.

Float Valves
Fairbanks, Morse & Co.

Flood Lights, Acetylene
Oxweld Railroad Service Co.

Floodlights, Electric
Syntron Co.

Fluxes, Welding
Oxweld Railroad Service Co.

Forgings
Bethlehem Steel Co.
Carnegie Steel Co.

Frogs
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Inc., Wm.

Fumigants
Calcyanide Co.

Gages, Measuring
Lufkin Rule Co.

Gas Switch Heaters
Ruby Railway Equipment Co.

Gates, Drainage
Armco Culvert Mfrs. Assn.

Generators, Acetylene-Carbic
Oxweld Railroad Service Co.

Grading Machinery
American Hoist & Derrick Co.
Bucyrus-Erie Co.
Western Wheeled Scraper Co.

Graphite
U. S. Graphite Co.

Grease, Track
U. S. Graphite Co.

Grinders, Portable
Ingersoll-Rand Co.
Syntron Co.

Grinders, Track
Railway Trackwork Co.
Syntron Co.

Guard Rails
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Carnegie Steel Co.
Q. & C. Co.
Ramapo Ajax Corp.

Guard Rail Clamps
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Q. & C. Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Hammers, Chipping, Scaling and Calking
Ingersoll-Rand Co.
Syntron Co.

Hammer Drills
Ingersoll-Rand Co.
Syntron Co.
Sullivan Machinery Co.

Hammers, Riveting
Ingersoll-Rand Co.
Sullivan Machinery Co.

Hammers, Pile Driving
Industrial Brownhoist Corp.

Hand Car Bearings
Timken Roller Bearing Co.

Heel Blocks
Bethlehem Steel Co.

Hoisting Machinery
Fairbanks, Morse & Co.
Industrial Brownhoist Corp.
Ingersoll-Rand Co.

Hoists, Air Motor
Ingersoll-Rand Co.

Hose
Ingersoll-Rand Co.

Insecticides
Calcyanide Co.

Insulated Rail Joints
Bethlehem Steel Co.
Q. & C. Co.
Rail Joint Co.

Jacks, Track
Verona Tool Works.

Joints, Compromise
Bethlehem Steel Co.
Q. & C. Co.
Rail Joint Co.

Joint Fastenings
Illinois Steel Co.

Joint Rail
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Co.
Q. & C. Co.
Rail Joint Co.
Wharton, Jr. & Co., Wm.

Joints, Step
Illinois Steel Co.
Q. & C. Co.
Rail Joint Co.

Junction Boxes
Massey Concrete Products Corp.

Knuckles, Emergency
Q. & C. Co.

Lamps, Car Inspectors'
Oxweld Railroad Service Co.

Lead, Red
National Lead Co.

Liners, Track
Rail Joint Co.

Lock Washers
Louisville Frog, Switch & Signal Co.
National Lock Washer Co.
Reliance Manufacturing Co.
Verona Tool Works.

Lumber, Treated
So. Wood Preserving Co.

Machines, Cutting, Oxy-Acetylene
Oxweld Railroad Service Co.

Speed and Comfort are Desirable—Safety is Essential

The Rail Joint Company

165 Broadway, New York, N. Y.

CLASSIFIED INDEX TO ADVERTISERS—(Continued)

Manganese Track Work
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Manholes
Massey Concrete Products Corp.

Markers
Massey Concrete Products Corp.

Mile Posts
Massey Concrete Products Corp.

Motor Bearings
Timken Roller Bearing Co.

Motors and Generators
Fairbanks, Morse & Co.

Mowing Machines
Fairmont Railway Motors, Inc.

Non-Derailer
Ramapo Ajax Corp.

Nut Locks
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
National Lock Washer Co.
Reliance Manufacturing Co.
Verona Tool Works.
Woodings Forge & Tool Co.

Nuts
Bethlehem Steel Co.
Illinois Steel Co.
Louisville Frog, Switch & Signal Co.

Out Houses
Massey Concrete Products Corp.

Oxy - Acetylene Welding Equipment
Oxweld Railroad Service Co.

Oxygen
Oxweld Railroad Service Co.

Paint
National Lead Co.
U. S. Graphite Co.

Paint, Graphite
U. S. Graphite Co.

Paint, Metal Protecting
National Lead Co.
U. S. Graphite Co.

Pavement Breakers
Ingersoll-Rand Co.
Sullivan Machinery Co.

Penstocks
Fairbanks, Morse & Co.

Pile Drivers
Bucyrus-Erie Co.
Industrial Brownhoist Corp.
Ingersoll-Rand Co.

Piling
Bethlehem Steel Co.
Carnegie Steel Co.
Massey Concrete Products Corp.
Southern Wood Preserving Co.

Pipe Carriers
Massey Concrete Products Corp.

Pipe, Concrete
Massey Concrete Products Co.

Pipe, Corrugated
Armco Culvert Mfrs. Assn.
Gohi Culvert Mfrs., Inc.

Pipe, Sewer
Armco Culvert Mfrs. Assn.
Massey Concrete Products Corp.

Plates, Miscellaneous
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Plows
Western Wheeled Scraper Co.

Poles
Jackson Lumber Co.
Massey Concrete Products Corp.
Southern Wood Preserving Co.

Poles, Treated
So. Wood Preserving Co.

Power Jack
Baldwin-Southwark Corp.
Southwark Foundry & Machine Co., Div.
Nordberg Mfg. Co.

Power Plants, Portable
Electric Tamper & Equipment Co.
Syntron Co.

Preservation, Timber
Curtin-Howe Corp.
Southern Wood Preserving Co.

Pumps
Fairbanks, Morse & Co.
Ingersoll-Rand Co.
Layne & Bowler, Inc.
Sullivan Machinery Co.

Push Cars
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Push Car Bearings
Timken Roller Bearing Co.

Rail Anchors
American Fork & Hoe Co.
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Lundie Engineering Corp.
P. & M. Co.
Verona Tool Works
Woodings Forge & Tool Co.

Rail Benders
Louisville Frog, Switch & Signal Co.
Q. & C. Co.
Verona Tool Works.

Rail Bonds
American Steel & Wire Co.
Verona Tool Works.

Rail Braces
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Q. & C. Co.
Ramapo Ajax Co.
Wharton, Jr. & Co., Wm.

Rail Expanders
Ramapo Ajax Corp.

Rail Layers
Buckeye Traction Ditcher Co.
Cullen-Friestedt Co.
Maintenance Equipment Co.
Nordberg Mfg. Co.

Rail Saws, Portable
Industrial Brownhoist Corp.
Syntron Co.

Rail Shims
American Fork & Hoe Co.

Rail Springs
Verona Tool Works.

Rails, Girder
Bethlehem Steel Co.

Rails, Tee
Bethlehem Steel Co.
Carnegie Steel Co.
Louisville Frog, Switch & Signal Co.

Reconditioning, Rail Crossing & Frogs
Morrison Railway Supply Corp.
Syntron Co.

Retaining Walls, Precast
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Rivets
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.

Rock Hammers
Ingersoll-Rand Company

Rods, Welding
Oxweld Railroad Service Co.
Syntron Co.

Roof Slabs
Federal-American Cement Tile Co.
Massey Concrete Products Corp.

Roofing, Cement & Concrete Tile
Federal-American Cement Tile Co.

Rules
Lufkin Rule Co.

Rust Preventive
Dearborn Chemical Co.

Safety Flags
Louisville Frog, Switch & Signal Co.

Saw Rigs
American Saw Mill Machinery Co.
Fairbanks, Morse & Co.

Saws, Electric
Reed-Prentice Corp.
Syntron Co.

Saws, High Speed Friction
American Saw Mill Machinery Co.

Saw Mills
American Saw Mill Machinery Co.

Saws, Portable, Rail
Q. & C. Co.
Syntron Co.

Saws, Timber
Reed-Prentice Corp.
Syntron Co.

Scales, Tape
Lufkin Rule Co.

Scales, Track
Fairbanks, Morse & Co.

Screw Spikes
Bethlehem Steel Co.
Illinois Steel Company.

Screw Spike Drivers
Ingersoll-Rand Co.
Nordberg Mfg. Co.
Syntron Co.

Sharpeners, Rock Drill Steel
Ingersoll-Rand Co.

Sheet Iron
Armco Culvert Mfrs. Assn.

Shovels
Verona Tool Works.
Woodings Forge & Tool Co.

Shovels, Gasoline Revolving
Buckeye Traction Ditcher Co.

Signals, Bridge & Warning
Hastings Signal & Equipment Co.

Siphons
Armco Culvert Mfrs. Assn.

Skid Excavators & Dredges
Northwest Engineering Co.

Skid Shoes
Q. & C. Co.

Slabs, Concrete
Massey Concrete Products Corp.

Smokestacks
Massey Concrete Products Corp.

Snow Melting Device
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Lundie Engineering Corp.
Q. & C. Co.
Ruby Railway Equipment Co.

Snow Plows
Q. & C. Co.

Spike Pullers
Louisville Frog, Switch & Signal Co.

Spikes
Bethlehem Steel Co.
Illinois Steel Co.

Standpipes
Fairbanks, Morse & Co.

Stands, Switch & Target
Bethlehem Steel Co.
Ramapo Ajax Corp.
Q. & C. Co.

Steam Shovels
American Hoist & Derrick Co.
Bucyrus-Erie Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Northwest Engineering Co.
Orton Crane & Shovel Co.

Steel, Alloy
Bethlehem Steel Co.
Central Alloy Steel Corp.
Illinois Steel Company.

Steel, Electric Furnace
Bethlehem Steel Co.
Timken Roller Bearing Co.

Steel Frame Houses
Butler Mfg. Co.

Steel, Open Hearth
Bethlehem Steel Co.
Carnegie Steel Co.
Timken Roller Bearing Co.

Steel Plates and Shapes
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Company.

Steel, Special Analysis
Bethlehem Steel Co.
Timken Roller Bearing Co.

Storage Tanks
Pittsburgh-Des Moines Steel Co.

Storm Sewers, Corrugated Iron
Armco Culvert Mfrs. Assn.

Stream Enclosures, Corrugated Iron
Armco Culvert Mfrs. Assn.

Street Culverts, Part Circle
Armco Culvert Mfrs. Assn.

Structural Steel
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Company.

Switch Guard
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.

Switching Engine
Baldwin-Southwark Corp.
Southwark Foundry & Machine Co., Div.

Switchmen's Houses
Massey Concrete Products Corp.

Switches
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Switchpoint Protectors
Maintenance Equipment Co.

Switchstands & Fixtures
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Tampers, Tie
See Tie Tampers.

Tanks & Fixtures
Fairbanks, Morse & Co.

Tanks, Steel
Pittsburgh-Des Moines Steel Co.

Tapes, Measuring
Lufkin Rule Co.

Telltales
Hastings Signal & Equipment Co.

Thawing Outfits
Lundie Engineering Corp.
Q. & C. Co.
Ruby Railway Squipment Co.

Tie Boring Machine
Syntron Co.

Tie Plate Clamps
Q. & C. Co.

Tie Plates
Bethlehem Steel Co.
Illinois Steel Co.
Louisville Frog, Switch & Signal Co.
Lundie Engineering Corp.

Tie Rods
Bethlehem Steel Co.
Louisville Frog, Switch & Signal Co.

Tie Spacers
Maintenance Equipment Co.

Tie Tampers
Electric Tamper & Equipment Co.
Ingersoll-Rand Co.
Syntron Co.

Ties, Steel
Bethlehem Steel Co.
Carnegie Steel Co.

Ties, Treated
Curtin-Howe Corp.
Southern Wood Preserving Co.

Tile, Roofing
Federal-American Cement Tile Co.

Timber, Treated
Southern Wood Preserving Co.

Tools, Electric
Syntron Co.

Tools, Pneumatic
Ingersoll-Rand Co.

Tools, Track Maintenance Equipment Co.
Q. & C. Co.
Verona Tool Works.
Woodings Forge & Tool Co.

Tongue Switches
Bethlehem Steel Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Track Bolt Wrench
Syntron Co.

Track Cranes
Buckeye Traction Ditcher Co.
Cullen-Friestedt Co.
Nordberg Mfg. Co.

Track Gages
Louisville Frog, Switch & Signal Co.
Verona Tool Works

Track Insulation
Q. & C. Co.

Track, Portable
Western Wheeled Scraper Co.

Track Shifter
Baldwin-Southwark Corp.
Southwark Foundry & Machine Co., Div.
Nordberg Mfg. Co.

Track, Special Work
Louisville Frog, Switch & Signal Co.
Ramapo Ajax Corp.
Wharton, Jr. & Co., Wm.

Trestle Slabs
Massey Concrete Products Corp.

Trench Excavators
Buckeye Traction Ditcher Co.
Industrial Brownhoist Corp.

Trucks, Hand Steel
Anchor Post Fence Co.

Tubing, Seamless Steel
Timken Roller Bearing Co.

Tunnel Warnings
Hastings Signal & Equipment Co.

Undercrossings, Corrugated Iron
Armco Culvert Mfrs. Assn.

Ventilators
Q. & C. Co.

Warning Devices, Bridge & Tunnel
Hastings Signal & Equipment Co.

Water Columns
Fairbanks, Morse & Co.

Water Cranes
Fairbanks, Morse & Co.

Water Supply Contractors
Layne & Bowler, Inc.

Water Tanks
Pittsburgh-Des Moines Steel Co.

Water Treating Tanks
Pittsburgh-Des Moines Steel Co.

Weed Burner
Fairmont Railway Motors, Inc.

Weed Killer
Chipman Chemical Engineering Co., Inc.
Q. & C. Co.

Welding and Cutting Apparatus, Acetylene
Oxweld Railroad Service Co.

Welding, Electric
Electric Railroad Sales Corp.
Syntron Co.

Welding Rods
American Steel & Wire Co.

Welding Supplies
Oxweld Railroad Service Co.
Syntron Co.

Welding Wire
American Steel & Wire Co.

Well Casings
Armco Culvert Mfrs. Assn.

Well Systems
Layne & Bowler, Inc.

Wheels, Hand & Motor Car
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Woolery Machine Co.

Wheels, Wrought Steel
Bethlehem Steel Co.
Carnegie Steel Co.

Windshields
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.

Wire Fencing
American Steel & Wire Co.
Anchor Post Fence Co.
Bethlehem Steel Co.
Page Fence Association

Wire, Welding
Oxweld Railroad Service Co.

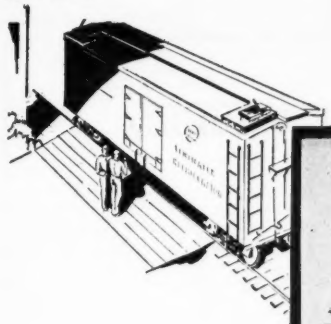
Wood Preservation
See Preservation, Timber

Wood Working Machinery
American Saw Mill Machinery Co.
Syntron Co.

Wrenches
Lowell Wrench Co.

Zinc-Meta-Arsenite Treatment
Curtin-Howe Corp.

STOP DECAY . . . WITH ZMA



ZMA Bridge Decking

Treated Lumber Suitable for Any Purpose

For maximum economic value and unrestricted use, treated lumber should be clean, paintable, and permanent.

ZMA lumber answers all these requirements—for bridges and trestles, freight houses, warehouses, stations, platforms and freight cars.

ZMA lumber is rot-proof and termite-proof. Carpenters do not hesitate to work on ZMA lumber, as it is clean and easy to handle.

May we consult with you regarding your problems? We know ZMA can save you money.

CURTIN-HOWE CORPORATION

Timber Preservative Engineers

405 Lexington Ave., New York, N.Y.

ALPHABETICAL INDEX TO ADVERTISERS

A

American Saw Mill Machinery Co. ... 590
American Steel & Wire Co. ... 581
American Well Works ... 583
Armco Culvert Mfrs. Ass'n ... 521
Associated Business Papers, Inc. ... 586

B

Baldwin-Southwark Corp. ... 518
Bethlehem Steel Co. ... 584
Buckeye Traction Ditcher Co. ... 585
Bucyrus-Erie Co. ... 530
Butler Mfg. Co. ... 533

C

Calcyanide Co. ... 590
Carnegie Steel Co. ... 577
Chipman Chemical Eng. Co., Inc. ... 526
Creepcheck Co. ... 575
Curtin-Howe Corp. ... 595

D

Dearborn Chemical Co. ... 587

E

Electric Railweld Sales Corp. ... 525

F

Fairmont Railway Motors, Inc. ... 512-513
Fairbanks-Morse & Co. ... 523-524
Federal-American Cement Tile Co. ... 527

G

Gohi Culvert Mfrs., Inc. ... 531

H

Hastings Signal & Equipment Co. ... 591

I

Illinois Steel Co. ... 579
Industrial Brownhoist Co. ... 517
Ingersoll-Rand Co. ... 516

J

Jackson Lumber Co. ... 585

L

Lowell Wrench Co. ... 584
Lufkin Rule Co. ... 591
Lundie Engineering Corp. ... 511

M

Mechanical Mfg. Co. ... 589
Medusa Portland Cement Co. ... 528

N

National Lead Co. ... 514
National Lock Washer Co. ... 597
Nordberg Mfg. Co. ... 534
Northwest Engineering Co. ... 515

O

Oliver Iron & Steel Corp. ... 519
Oxweld Railroad Service Corp. ... 520

P

P. & M. Co. ... 509
Page Fence Ass'n ... 588
Pittsburgh-Des Moines Steel Co. ... 590
Porter, Inc., H. K. ... 588

R

Rail Joint Co. ... 593
Railway Trackwork Co. ... 587
Ramapo Ajax Corp. ... 536
Reliance Mfg. Co. ... 510

S

Simmons-Boardman Publishing Co. ... 582
Southern Wood Preserving Co. ... 589
Southwark Foundry & Machine Co. Div. ... 518
Syntron Co. ... 522

T

Taylor-Wharton Iron & Steel Co. ... 583
Timken Roller Bearing Co. ... 598

U

U. S. Graphite Co. ... 591

V

Verona Tool Works ... 529

W

Wharton, Jr. & Co., Wm. ... 583
Woodings Forge & Tool Co. ... 573

LONG LIFE TO THEM ALL!

Your rails, nuts, bolts, joint bars — and to a smaller degree all your equipment that passes over them will last longer if you protect your track with Improved Hipowers.

Will you talk it over with us?

THE NATIONAL LOCK WASHER COMPANY

Newark, New Jersey, U. S. A.

IMPROVED HIPOWER

The High Pressure Spring Washer. Ultimately costs less. Flexibility essential to expansion and contraction of rail. A non-flattenable spring in heaviest service — never an inert flat filler. Ask those experienced in track maintenance — they know.

A Timkenized train of Fairbanks-Morse "Sheffield" section cars

This train is made up of a No. 40B "Sheffield" section motor car and two "Sheffield" trailers. The motor car is equipped with two Timken Bearings on the engine crank shaft and four Timkens on each axle. The trailers are equipped with four Timkens on each axle. There is no better protection against the weight, thrust, shock, speed, neglect and abuse that section cars have to stand.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

1931

S